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FOR ALL WORKMEN, PROFESSIONAL AND AMATEUR.

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A HANDY FOLDING BENCH FOR WOOD WORKERS.

BY DAVID DENNING

PERHAPS the following account of a small carpenter's bench may be of some assistance to wood workers who are cramped for room, as I was when I contrived the one I purpose describing. It certainly was not as good as a properly-made bench, but then this takes up a considerable amount of space, and, moreover, requires almost a special workroom. In the house at which I was then living, no such room was available, and the domestic workshop had to be dispensed with—only for a time, however; for before very long the contrivance to be described was rigged up, and, in default of a better, answered its purpose well enough. One often hears amateurs complain of having no place which they can use as a workroom; but, after all, there are, I take it, comparatively few houses in which they might not gratify their tastes. In the one referred to, there seemed no likely spot, and the position I ultimately chose—it certainly was "Hobson's choice:" either avail myself of it or go without a bench—may not commend itself to the fastidious worker. I mention the situation and surroundings to encourage others who may be similarly placed. To begin with the "shop" was underground, and, beyond a mere glimmer, no daylight was ever visible in it. It was, in fact, nothing but an underground passage from which coal cellar and larder opened out. A permanent standing bench of the usual size was out of the question, and I resolved to see what could be done with a folding one. It should be said that no heavy work was contemplated, nor yet any of large size. The limited area, apart from other considerations, would prevent that, something that would do for odd jobs and small work being quite sufficient for my purpose. Therefore those in whose minds the above title may have raised visions of a perfectly appointed work bench and all its accompanying outfit will, I fear, be disappointed; still others, no doubt, will welcome a few suggestions which, however primitive they may be, at least have the merit of being based on personal experience. It may further be added that no unnecessary expense was incurred, and that this, as will be seen, was of the most trifling character. Were I to suggest possible improvements, whatever value there might otherwise be in the following description I fear would be reduced. I shall, therefore, content myself with saying that the bench, though of the crudest form, answered very well in the circumstances, and I think it will be more helpful to tell exactly what it was than to tell how it might be improved on.

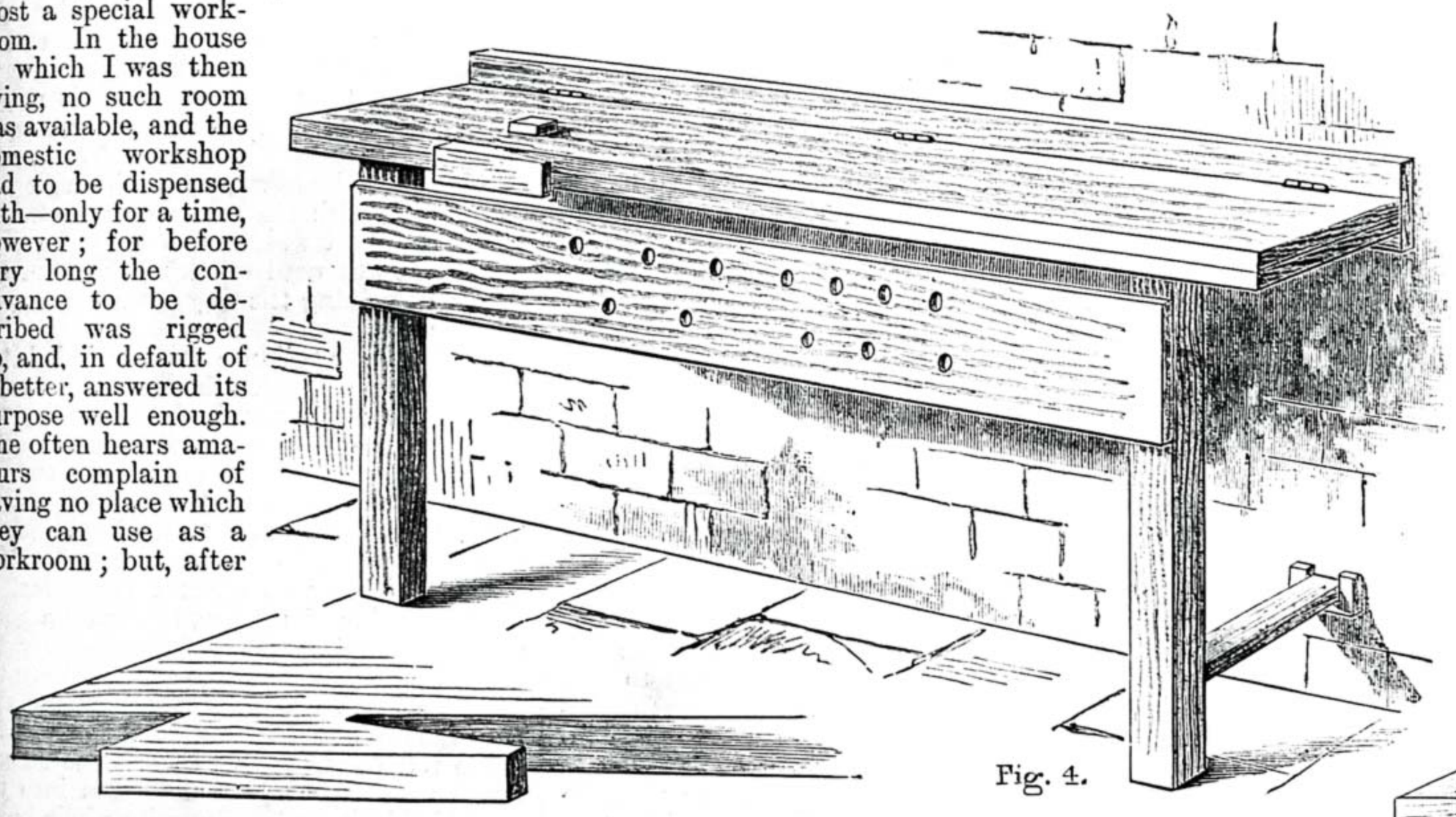

Fig. 1.

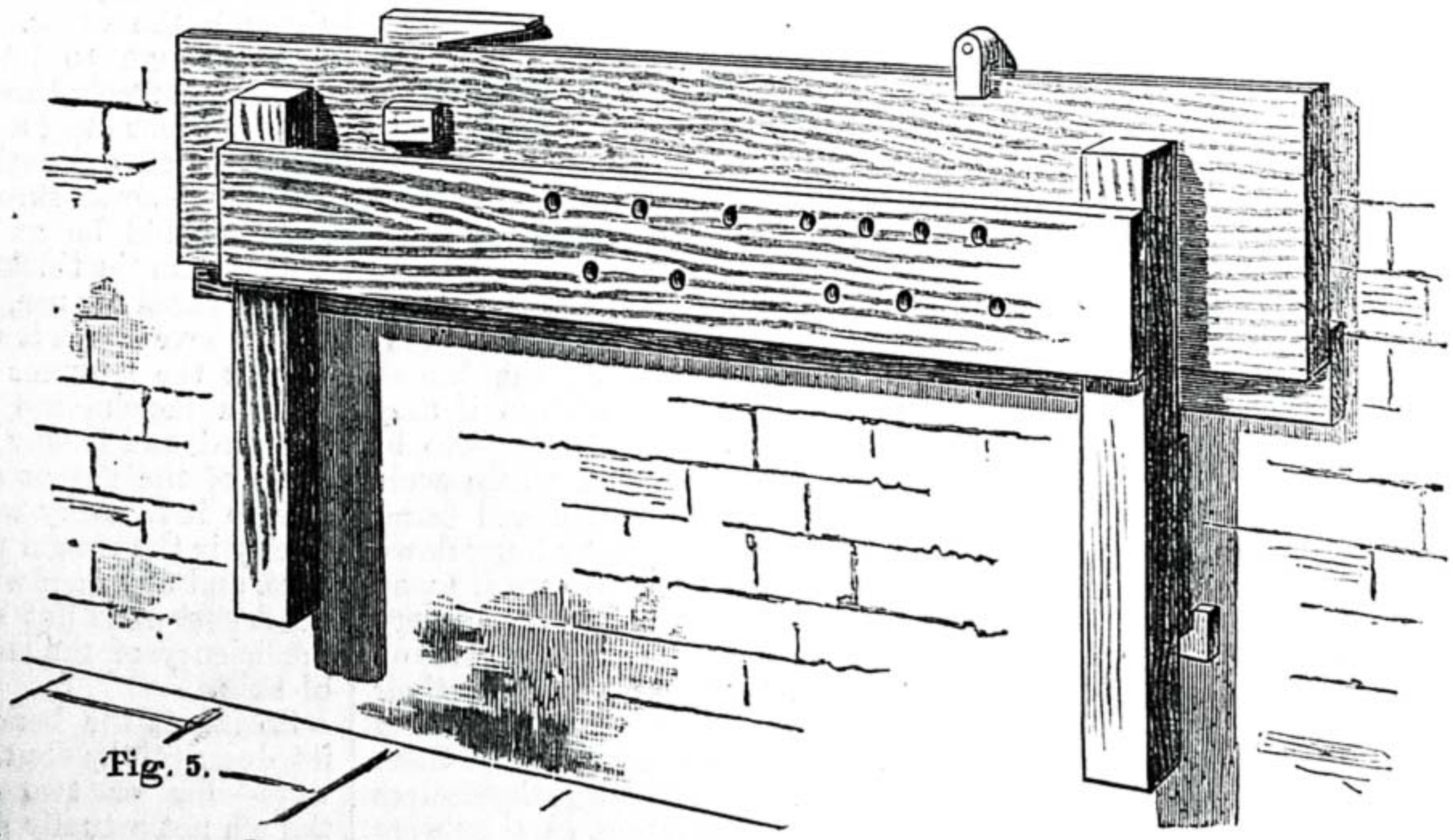

Fig. 4.

Fig. 2.

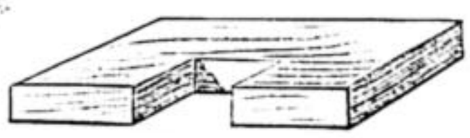

Fig. 3.

In order to get to one of the compartments opening out of the passage—the coal cellar, I think—it was necessary that the bench when folded should not project more than a few inches from the wall to which it was attached, and only one part of the wall was available for this purpose. Fortunately, there was a gas bracket just above the place the bench was to occupy, so that no great inconvenience was caused by the light. If that from the fixed bracket did not suit for any particular piece of work, the difficulty was easily got over by having a piece of indiarubber tubing and a very

Fig. 5.

Fig. 1.—Stop instead of Bench Screw. Fig. 2.—Catch to hold Bench to Wall. Fig. 3.—Stop for Legs. Fig. 4.—Bench down for Use. Fig. 5.—Bench folded against Wall.

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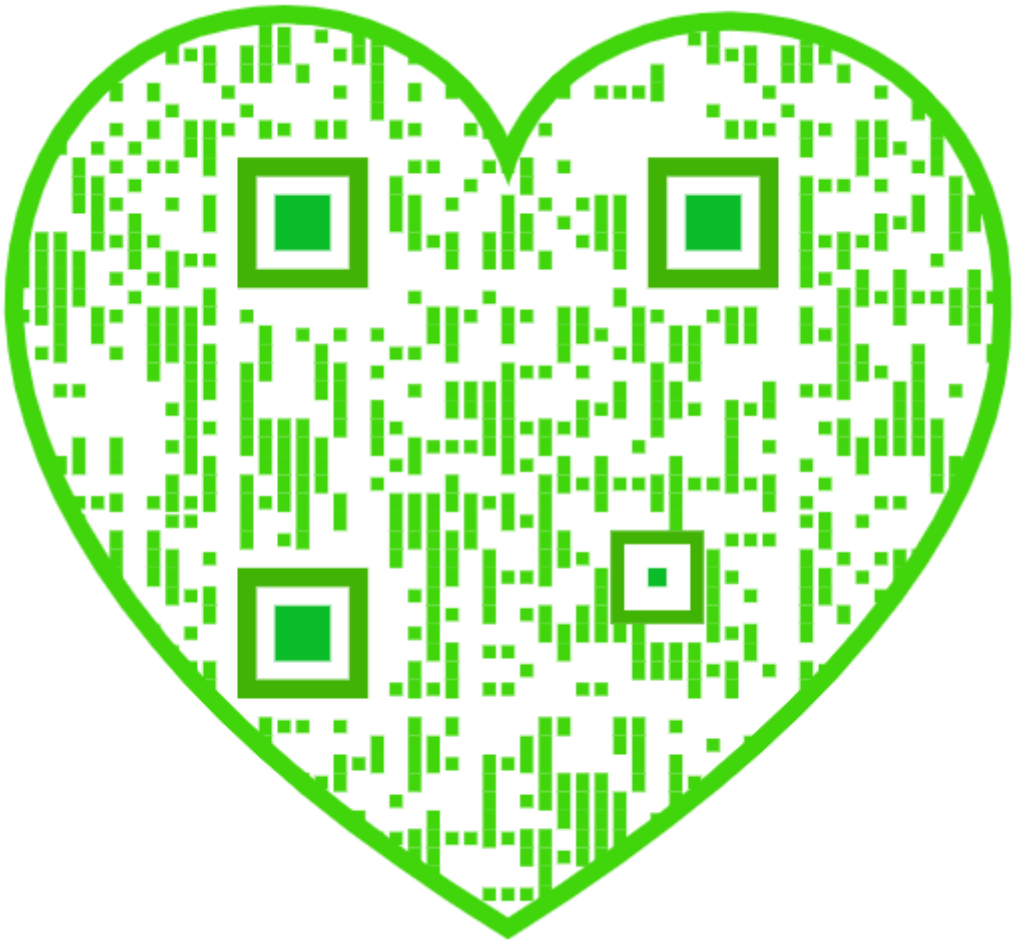

rough but serviceable portable gas stand or bracket. A description of this must, however, stand over, as it can hardly be considered part of the bench.

The top of this was formed of a couple of 1-in. pine boards, screwed together to form one piece. Only the top surface and front edge were planed over, the remainder being left quite rough. Perhaps I should say that when I began it the intention was that the bench should be only of a temporary character, or a little more care might have been taken both in material and finish. Pine, for instance, is not so suitable for the purpose as some harder wood, though this, after all, is only preferable on account of its being more durable and not so likely to be injured. The screws, of course, were driven in through the bottom board, care being taken that their points did not project beyond the upper surface. By using plenty of them—and, if I remember, some glue between the two boards—a plank practically as useful and solid as if it had been formed of one piece was got. The only reason for building the top up in this way was that I happened to have the inch stuff by me, but had none thicker. If I had had any sufficiently thick I should have used it, and avoided the then unnecessary labour of screwing two pieces together. The size of the top was about 4 ft. long + 11 in. wide. To attach this to the wall another piece of wood, say 4 in. wide, was taken, the same length as the top and of 1-in. stuff. Writing from memory, I am unable to give exact sizes, but these are of little consequence, as if the principle of the contrivance be understood there will be no difficulty in any one making a similar bench of such dimensions as may be most convenient to himself. Where sizes are mentioned, it will therefore be understood that they are given more by way of suggestion, though in the main they approximate very closely to those used. I should explain here that the wall to which the bench was fixed was of brick, not of lath and plaster, so that there was no great difficulty in securely fastening it. Lath and plaster are, no doubt, good enough in their way, but I don't advise any one to fit his bench against such a wall; but even then, by tapping on them, he will soon find out where the solid wood into which nails may be driven lies. However, in a brick wall holdfasts were easily driven—too easily, indeed—into the mortar, or stuff so called, and sufficiently resembling it to have passed the authority duly appointed to certify that everything was fit and proper. We who have inhabited houses erected by the speculative builder know how very careful he is only to use the very best of everything; otherwise, in this particular instance, in my ignorance I should have called his mortar sand. Whatever it was, nails would not hold in it, and it is not altogether easy to drive them into bricks. The alternative, therefore, is to plug the walls wherever a nail is to be inserted. This I managed, and I think it is a way commonly adopted, by clearing out some of the mortar here and there between the bricks, making, in fact, a good hole between them, and hammering in pieces of wood to tightly fill them. A small ordinary hammer is no good for this, but the coal hammer will do very well, as it is of the utmost importance that the plugs or wedges be very tightly fitted in. Nails may then be driven in and held securely.

The wall having been prepared at a suitable height for the bench, the piece of wood by which it has been stated it is attached to the wall was nailed up. The extra hold which nails have when driven in slantingly in opposite directions has already been referred to in an early number of Work by Mr. Adamson, in his articles on "Artistic Furniture," and the novice cannot do better than refer to them.

With regard to the height of such a bench there is no reason why the maker should not suit his own convenience. The practised worker becomes accustomed to work at the ordinary bench height, but it seems absurd, apart from custom, to suppose that one height can be naturally the most convenient for both tall and short people. I venture on this digression to prevent any amateur thinking that the regulation height of benches must necessarily be the best for him whether he be short or tall. Let him choose the height at which he can have the most command over the tools he is using, and that this in practical workshops is to a great extent a matter of custom may be seen by noticing the equal facility with which both the tall and short men work at benches of the same height. The amateur who may be supposed not to be able to work more freely at one height than another should have his bench at such a height that he can do his work conveniently without the necessity of stooping too much. At the same time, he must not have it so high as not to be able to stand well over his work. It will thus be seen that considerable latitude is allowable, although no doubt something near ordinary bench height is about the best. This may be stated as about 2 ft. 6 in. Personally, I find this the best; but an inch or two for general work does not make much difference. In an ordinary bench the height can be easily altered by either cutting the legs shorter or putting something under them; but as this folding bench is hinged to the wall, it will be as well to decide beforehand on whatever height may seem most convenient, to avoid troublesome alterations afterwards.

Three good strong iron butt hinges formed the connection between the top and the piece nailed to the wall. The hinges were fastened to the back edge of the top with knuckles upwards, as the top, when the bench was not in use, was designed to fold in this direction, and not to hang downwards. Those who have read the recent instructions on "Hinges" will not require to be told that back flaps might be used instead of butts, and that they would have to be fastened to the upper surface of the top, or, rather, sunk into it. For further directions about this part of the work the beginner who has no very definite ideas how to go about it may be referred to the above-mentioned articles, in order to save recapitulation of the instructions they contain.

So far as we have gone, it will be seen that the bench, though supported behind, has nothing to sustain it in front. Without some arrangement to do so, the hinges could not bear the strain, nor even if they could would the top be rigid enough to be worked on. I used two legs, which were hinged to the top near the ends and front, so that on this being lifted they hung down and were out of the way. They were, if I may use so grandiloquent a word to such a very simple arrangement, self-adjusting, for on lowering the top they naturally fell into their proper position, and required the smallest possible amount of humouring to get them in their places exactly. The legs themselves require very little description, as they were simply a couple of $2\frac{1}{2}$-in. squares; one of them, I think, was an old kitchen table leg, and the other was an odd bit that came in handy. Beyond cutting them to the right length and squaring off both ends, they required no preparation.

Back-flap hinges were used to attach them to the top, one to each leg, where, of course, it was fastened to the back. Before hingeing them to the top both legs were connected by a piece of board. This was nailed on to the front sides, and being subsequently bored with holes, in which pegs were placed, served to support boards while their edges were being planed up. The width of the board was not great, say, 8 to 10 in., as no large work was done on the bench. It was of 1-in. stuff, and the holes were simply made as wanted till there were enough of them with a centre bit.

I have mentioned this board, as on its thickness depends to some extent the exact distance at which the legs are placed from the front edge of the top.

Perhaps I can make their position clear by saying that the front of this board should be flush with the front edge of the top when the bench is in use. The object of this will be apparent on trial if it is not already so.

At first, instead of a bench screw, I used a small stop, screwed to the front edge of the top, as shown in Fig. 1, the triangular space being prepared to jamb the end of anything being planed up into it. Of course this, though fairly good, is not so satisfactory as proper bench screws, of which I afterwards got one. These, as I daresay is well known, are both single and double, *i.e.*, with either one or two screws; and it is almost needless to say that only a single one was used on this bench. A few words describing the way it was fixed may not be amiss.

With the appliance are included two blocks, one of which is threaded for the screw; the other simply fits quite loosely. The former one must be fastened in some way to the bench top, so that on turning the screw the other is brought up to this as far as may be necessary to hold anything it may be desired to fix. I managed as follows. The screwed block I made fast to the under-side of the top, removing a piece of the board last referred to away for the purpose of affording it space. To keep the movable block with its upper edge level with the top of the bench, I affixed a wooden guide rod to it. This was of some strong, tough wood—probably ash—glued into the movable block, and sliding with a hole bored through the other. This hole should be large enough to let the guide pass quite easily and freely through it.

As a bench stop, a piece of wood was used which fitted quite tightly within a rectangular hole bored through the top. The stop itself should be at least an inch or two longer than the thickness of the top. When not required for use, a tap with the hammer from above levels it with the bench, and to raise it the hammer is applied underneath. Such a bench stop is by no means to be despised, and it may be questioned whether some of the patent arrangements are superior to it in every way. Anyhow, its simplicity is the reason why it is recommended here, and any man who can't use it may depend that it is not so much owing to the inefficiency of the stop as to his own want of skill.

So far as the bench goes this completes its description; but there are—or, rather, were—one or two little matters which, though not actually part of itself, in connection with it may very appropriately be noticed. For one thing, it soon became

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evident that when folded up against the wall something more than a piece of board resting on the ground was necessary to keep it there. Somehow or other, the end of that unfortunate plank, which seemed quite out of the way, was always coming in contact with somebody's beetle-crushers, or they with it. It was not altogether satisfactory, and nobody ever thought, apparently, that it might be avoided by the simple expedient of walking in the centre of the passage. My own private conviction is that before that bench was put up those who used the passage kept close to the wall on the side opposite to it; ever afterwards, however, rubbing along the bench side, till I put up a catch, which held the bench to the wall. This catch, like everything else about the bench, was of the most simple construction. It is shown in Fig. 2, which explains it so clearly, that remarks about it can hardly be necessary. It was made of wood, and was hung on a screw nail, the neck of which passed loosely through it. The thickness at one end, of course, was merely to keep the catch end away from the wall; but if the screw were put through the middle of a sufficiently long piece of wood it would do just as well. In this case, it would not do to screw the wood close up to the wall, as a sufficient space would have to be left for the thickness of the top.

Another little arrangement, if not an absolute necessity, was at any rate soon found to be a convenience. When working at the bench its front supports were apt to get pushed back, as, of course, there was nothing to stop them at the bottom.

This having resulted once or twice in an upset of everything that was lying on the bench at the time, led to the stop, as shown in Fig. 3, being fixed to the floor. One or two nails being driven in between the flagging prevented it being forced backwards, which was all that was necessary, there being no upward strain. These blocks were rather in the way of people passing to and fro, so these were altered for another arrangement, which got over any difficulty of that kind. To the back of each leg I hinged a piece of wood, to fold upwards when required and at other times to extend backwards as far as the wall, where it rested in a cleat of very similar shape to that which had been previously used on the floor. This arrangement prevented any further mishaps, and served till the bench on removal to another house was finally dismantled.

In connection with this, I may mention a convenient way of keeping one's tools—at least, a good many of them; for, as will be seen, it is not suitable for planes, large saws, and a few other things. For chisels, screwdrivers, and all the smaller articles, it is well adapted, especially if, as in this case, the bench is against a wall. The tools are visible, and each can be reached down as required and put up again when done with without any of them lying about on the bench—an important consideration with a small one. Every one knows the waste of time caused by hunting up a tool, whether it be from among others lying on the bench or from the chest, and all this can be avoided by slinging them in a kind of rack against the wall. I call it a rack, as I do not know very well how to describe it otherwise; but the name does not matter much so long as the contrivance is understood. A piece of wood, say 2 or 3 in. wide and $\frac{1}{2}$ in. or so thick, of any convenient length, forms what may be called the foundation. On this some upholsterer's chair webbing is fastened with tacks, the web being left loose lengthwise between the tacks, so that it forms a series of loops. In these loops the tools are placed, blade downwards. The handles prevent them slipping through. So convenient have I found this arrangement that I regularly keep many of my tools permanently this way in preference to any other. For instance, my lathe—a Britannia, No. 10—stands in a recess of my workroom, for, fortunately, I am not driven to a cellar passage now. Behind it are arranged my turning tools. On another piece of wood, similarly looped with web, are my carving tools. In a workroom tools hung this way are not only ornamental, but, what is more to the purpose, it is very easy to select any one that may be required.

It seems, somehow or other, that this description of my folding bench has run on to a considerable length; but all I can say in extenuation is that when I was a younger and a wiser man (in my own esteem) I should have been glad of similar suggestions to assist me. That these are perfect I do not pretend; but, in the belief that they will be welcome to some among the hundreds of thousands of all sorts and conditions of men who read WORK, they are set down in black and white.

Everything that seems necessary has been described; but if the written explanation is not sufficiently lucid few will experience the slightest difficulty in knowing what is meant if they will refer to the accompanying illustrations (Figs. 4 and 5), the first of which shows the bench open for use, the latter closed or folded against the wall. Should I not have made myself sufficiently intelligible, I will endeavour to rectify any defect in the "Shop" columns, only—may I, without offence, say it?—I would suggest that it will be better for the young worker not to write off immediately he meets with a difficulty, but to try and solve it for himself. It will prove much more useful to him to do so, and he must remember that the object of this article is not so much to tell him how to make a bench exactly like, or, in other words, a copy of, mine, as to suggest plans by which he may profit. Still, should any one meet with a difficulty he feels himself unable to surmount in fitting up a similar bench, I will gladly help him as far as I can in "Shop."

LOCK REPAIRING AND KEY FITTING.

BY THOMAS WILSON.

PATENT LOCKS FOR SAFES.

As I remarked at the conclusion of my last article, ordinary lever locks afford ample security for general purposes, but for safes, or where perfect security is required, it is necessary to render them unpickable. There are various means in use for attaining this end, most of them protected by patent. It would be outside the scope of this article to describe all of them, but I will briefly describe those of Hobbs, Chubb, and Bramah, inasmuch as they have been before the public longest.

Messrs. Chubb use levers with notches (or false gatings as they are technically termed) cut in them, as shown in Figs. 1 and 2, so that the bolt stump (Fig. 3) can enter a short distance, and where these are numerous it is almost impossible to tell if the bolt has entered the true or false gating. The makers, however, do not rely entirely on these, for they use a detector, which, briefly described, consists of a trigger so arranged that if any lever is raised too high the bolt is blocked, and it cannot be withdrawn even by its own key. It can, however, be released by turning the key slightly in the other direction. This detector, besides assisting in rendering the lock unpickable, serves to show if the lock has been tampered with. Messrs. Hobbs rely on their patent movable stump, shown in Fig. 5, by means of which any pressure, if applied to the bolt before raising the levers, is transferred to a fixed part of the lock, so that the levers are perfectly free. Both these methods render the locks practically unpickable.

There is one other defect in lever locks which I have not mentioned, and that is the risk of the bolt step, A, shown in the key, Fig. 9, being worn (or, perhaps, wilfully filed or ground down) so that it is not long enough to throw the bolt home, which remaining in the passage of the levers can easily be thrown back by an ordinary pick. To obviate this danger, Messrs. Hobbs introduced their patent protector, in which the bolt step or talon is fixed to a revolving nozzle instead of on the key (see Fig. 4). With these improvements their locks may be said to be perfect. Space will not permit of mention being made of the inventions of Chatwood, Tucker, Parnell, Tann, Price, Fenby, Hart, Cottrell, and Hodgson, all of which have demonstrated the possibility of producing locks capable of defying picking instruments in the hands of experts.

To cut a key to a lever lock it is necessary to remove all the levers, laying them carefully on one side in the order in which they are taken out. Now cut the first step in the blank so that it will throw the bolt, then replace the first lever and cut the second stop so that it only raises the lever to the necessary height to allow the stump on the bolt to pass the gating; next replace the second lever and proceed in the same manner, continuing until all the levers are replaced and the corresponding steps cut in the key. Fig. 9 shows a lever key for a night latch. The first step in this is a sham, as the bolt is thicker than the lever, and takes up the first two steps, so that it follows that the key belongs to a four lever lock. It will not do, however, in buying a lock, to be guided by the key unless it is by some well-known maker, as I have known a lock with only two levers have a key like the illustration (Fig. 9), the levers being kept in their places by a pin riveted in the covering plate, so that it is as well, in buying a lock, to have the covering plate removed and see that the levers are actually there. Fig. 6 shows a Bramah lock. This well-known lock is in principle the same as a lever lock, but instead of levers small guards of sheet metal (Fig. 8) are used. These work in a cylinder (Fig. 10), carrying a stud which turns the bolt; a flat steel ring (Fig. 11) projects into a groove in this cylinder, and the ring is notched to correspond with the notches in the guards, as shown at A, Fig. 8. In unlocking, the key presses the guards down until the notches are opposite the corresponding notches in the ring. The cylinder can then be turned round and the bolt thrown back, a small spiral spring at the back of the guards replacing them in position when the key is withdrawn. Those made by Messrs. Needs and Co., the successors to Joseph Bramah, the patentee, are very secure, but common Bramah locks are seldom perfect, and can be opened in many different ways.

To cut a key to one of these locks it is necessary to fit the blank to pass the outside cylinder, then to take off the cylinder, when

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it will appear as shown in Fig. 10, with the ring, Fig. 11 (which is in two pieces), in position in the groove, B B; now file down the end of the blank until the stud on the key nearly enters the cylinder, then blacken the end and press it in the cylinder. It will then show the impression of the guards on the end, and these should be cut down equally in the blank for a short distance, say, an eighth of an inch. The cylinder should now be held in the hand with the key pressing it, so as to see the distance back the handle with a piece of wire. Fig. 12 will illustrate my meaning. For this reason I prefer Chubb's Combination Night Latch, in which the levers themselves form the bolt, and which is opened from the inside by turning a handle, and not by drawing it back. A night latch on this principle can now be bought for as low as 3s. 6d. or 4s., and is about the best that can be used. No direction need be given for cutting keys to this kind of lock, as all lever keys are cut in the same manner as twisted round the joint. Get a pennyworth of borax, powder and moisten a piece of it (do not buy it powdered as it is not pure), and put a little over the brass wire. Now hold it with a pair of tongs in the fiercest fire at your command. An ordinary kitchener will do if all the dampers are opened and a clear fire made; in fact, I have brazed them in this way myself, when a long distance from the shop. An ordinary grate would probably do if the top was covered down to the bars with sheet iron to increase

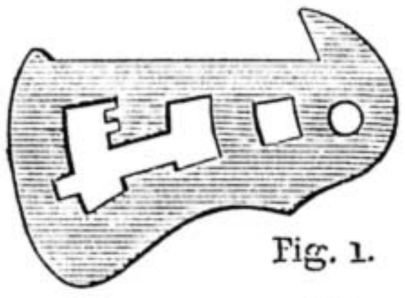
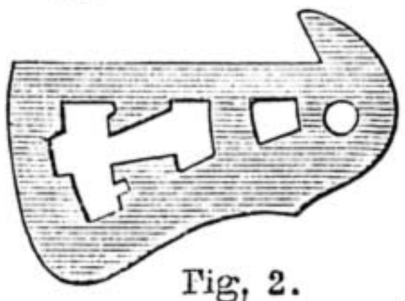
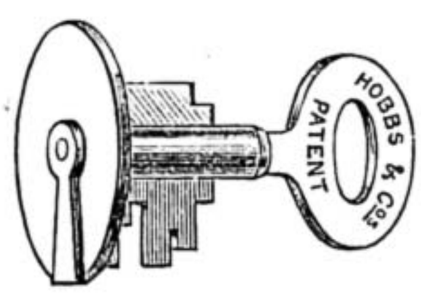


Fig. 1.



Fig, 2.



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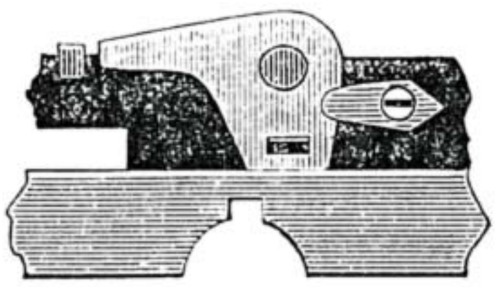


Fig. 5.

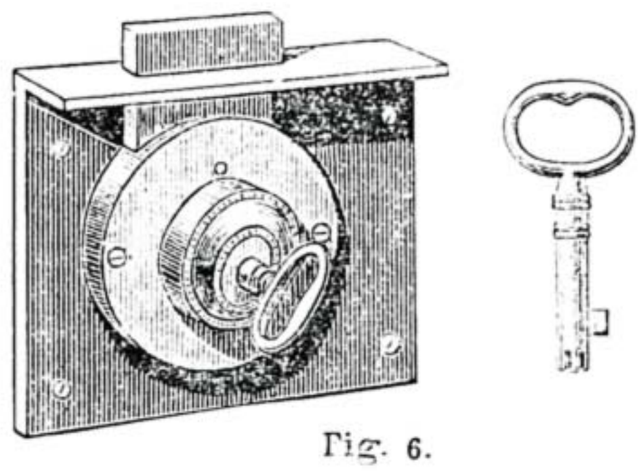
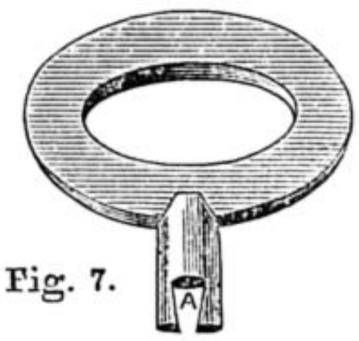


Fig. 6.

Fig. 3.



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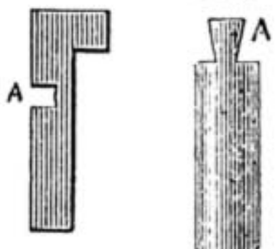

Fig. 8.

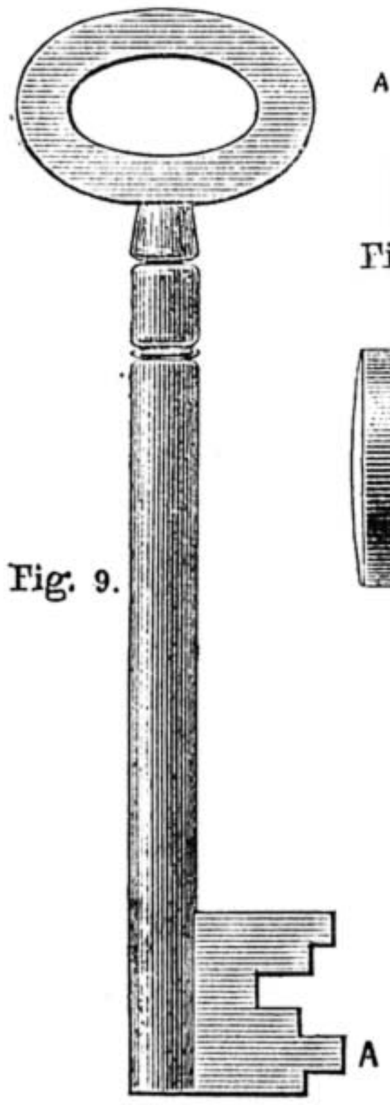

Fig. 9.

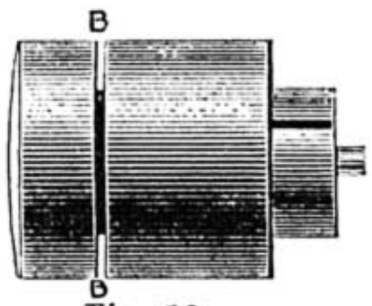

Fig. 10.

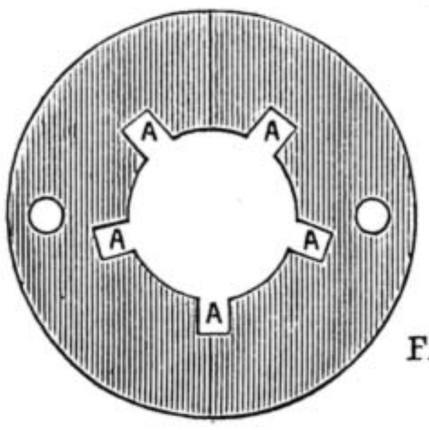

Fig. 11.

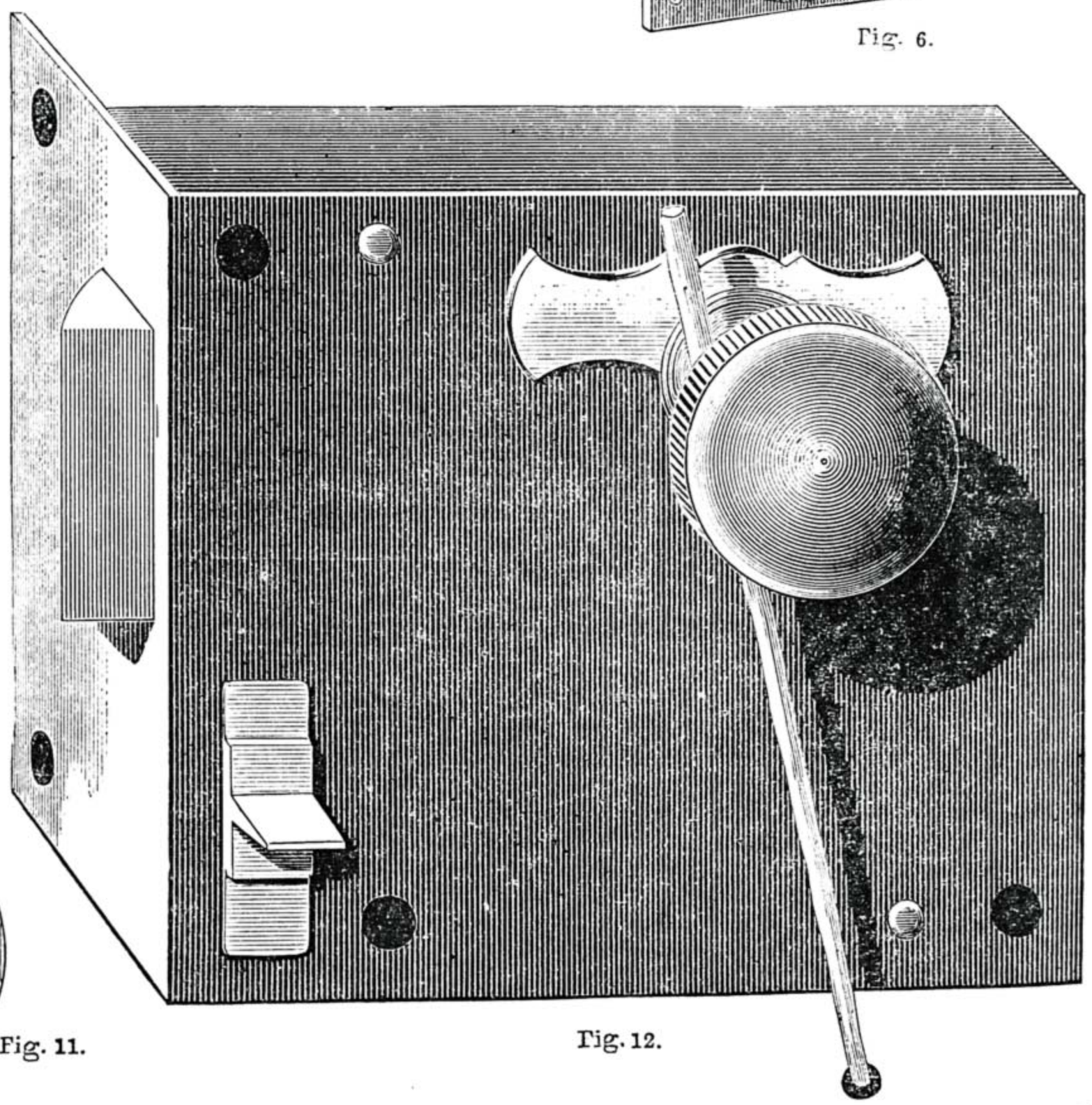

Fig. 12.

Figs. 1 and 2.—Chubb's Levers with Notches or False Gatings. Fig. 3.—Bolt Stump. Fig. 4.—Hobbs' Patent Protector. Fig. 5.—Hobbs' Patent Movable Stop. Fig. 6.—Bramah Lock (Till Lock). Fig. 7.—Dovetailing New Bow to Key. Fig. 8.—Notches in Guards. Fig. 9.—Key for Lever Lock, showing Defect at A. Fig. 10.—Cylinder of Bramah Lock (Night Latch). Fig. 11.—Ring. Fig. 12.—Mode of opening Night Latch.

necessary to cut the notches in the key, which may be ascertained by holding the cylinder to the light and looking at the groove, B B. The notches in the key should be cut down one at a time, until the gatings in the guards are opposite the grooves in the cylinder, when if the lock is put together the key will be found to fit.

These locks are now seldom used for safes, but they are frequently used for purposes where a small key is preferred, such as night latches, jewel cases, etc. For night latches, however, they cannot be recommended, as like all drawback locks, however good the works may be, they can easily be opened by boring a hole under the latch, and turning previously described. Before closing this paper, it may be as well to describe the method of repairing a broken key (broken, that is to say, at the bow, for if the bit is broken it cannot be repaired). If the bow is twisted off and not damaged, a slot should be filed in the top of the key and the bow driven on, but should the bow be broken, an old key must be found with a sound bow.

In ironmongers' shops all old keys are preserved for the sake of the bows, so that one could be bought for a trifle, if there did not happen to be one in the house. Having procured the bow, it and the key should be dovetailed together, as shown at A A, Fig. 7, and a few strands of brass binding wire the draught. When the brass has melted, turn the key round once or twice until it has cooled, so that the brass may be equally distributed, and then put it on one side to cool. Take off the surplus brass, and clean up the key with emery cloth, and it is finished, and will be found equally as strong as a new one.

I think I have enumerated now all the ordinary repairs incidental to locks in general use, and have enabled those of a mechanical turn of mind to keep their own locks in repair at a very small cost. As I stated before, I shall be pleased to give any information that may be required through the medium of "Shop."

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METAL SPINNING.

BY F. J. DURRANCE.

To those of my readers possessing a lathe, there can be no more interesting or pleasant way of using it than in the process of metal spinning. Very little is known amongst amateurs of this method of sheet metal working, too little, in fact, considering that hundreds of useful articles in daily use can be easily and simply made by this process—pin trays, egg-cups, candlesticks, etc. And most of the articles produced are specially fitted for embellishment by the two methods known to readers of WORK as repoussé work and chasing. The tools required are very few, and can be easily made by any one having a little mechanical knowledge. And the necessary skill is soon acquired, and the results obtained very satisfactory. Now to work. Presuming you have a little knowledge of wood turning, I will commence by describing the making of the simplest thing I can think of—a cigar-ash tray. Take a piece of hard wood of a close grain (beech or birch for instance), about 4 in. square and an inch thick; by any of the well-known methods, fasten it to a chuck. A good way is by the taper screw, or attach it to the face plate by screws from the back, Fig. 5. Now turn it up to the shape of sketch, Fig. 1 (the drawings are not to size, merely theoretical); make it nice and smooth, but do not polish it. Next get a piece of sheet metal to commence practice—lead, pewter, or better still, sheet zinc used for covering the counters of hotel bars is preferable, as it keeps its colour and takes a good polish. Most plumbers will pick you enough out of the scrap for a few coppers. Now cut a piece of metal a little larger than the pattern mould, and attach it to the face of pattern; this is the most difficult thing in this work, to hold the metal close up and prevent its turning. In this case we turn up a piece of hard wood the shape of Fig. 2, then put a little powdered resin on the flat surface of pattern, also a little on the largest face of the retaining block, insert the metal sheet *between* the two, and bring up the back centre against the small end of block. Run the lathe slowly round, and centre the metal sheet. Now screw up the back centre *firmly* and lock it, put a little oil on centre, and we are now ready to begin (see Fig. 3 showing all *in situ*). But as we cannot go on without tools these must be our next consideration. These consist of pieces of steel of various forms, and really consist of what are known as burnishers; for the work we have in hand a simple piece of steel rod or wire, about $\frac{3}{16}$ in. thick, rounded off at the end, smoothed and polished, and driven into a good long handle, will do, although it is always preferable to have the steel of *flat* section, square or oblong, as they lay flat on the rest and do not require so much holding. We now come to the *rest* used for this work, which is rather different to that used for wood, but very similar to the one used for metal turning. It is flat on the top, and has a few holes drilled into the upper surface for the purpose of inserting steel pins (see Fig. 4); the lower part fits into the T rest, and is fastened by a screw in the ordinary manner; put on a good quick speed for this work, the quicker the better. Now look carefully at the theoretical sketch, Fig. 6, fix the rest in the position shown, and just a

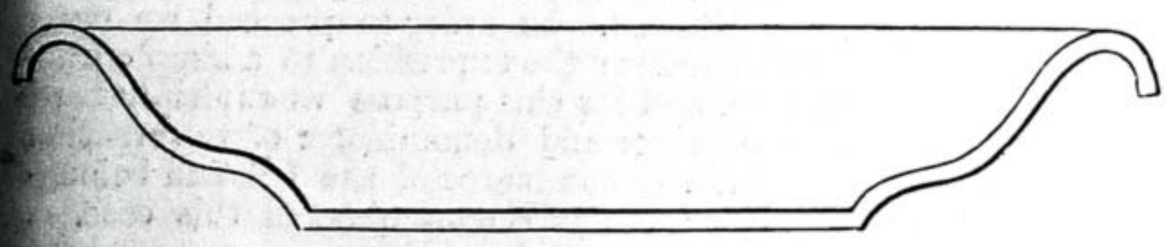

Fig. 1.—Section of Small Tray as Subject for Metal Spinning.

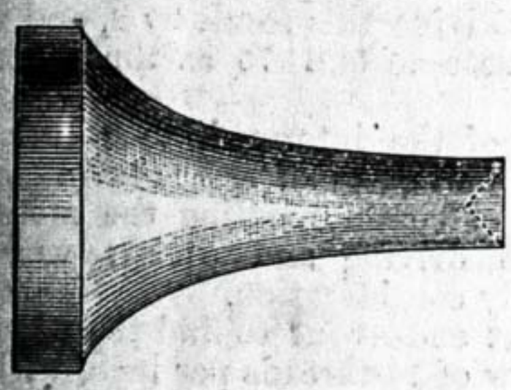

Fig. 2.—Shape of Piece of Turned Wood to hold Metal in place.

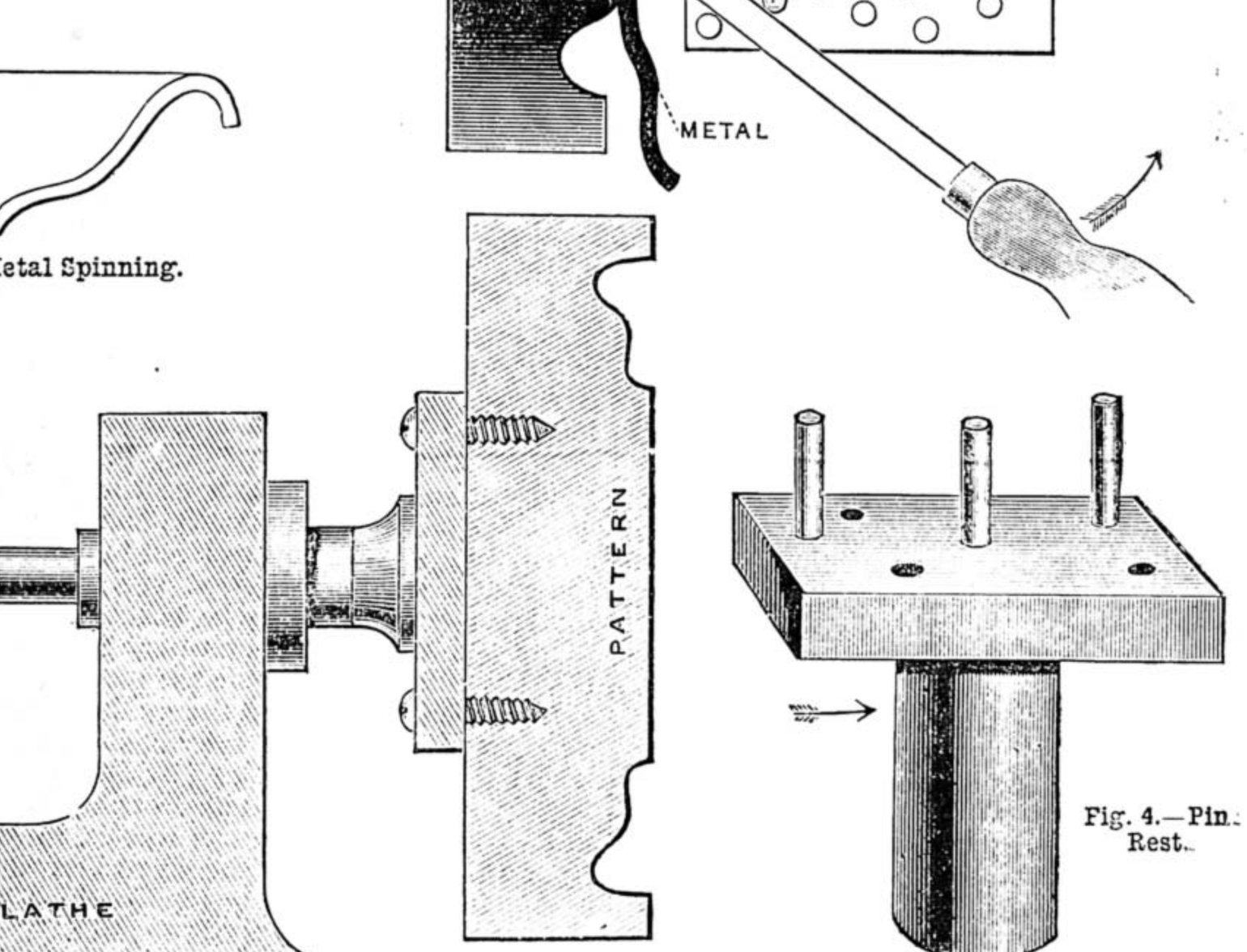

Fig. 5.—Mode of Turning Pattern on Lathe.

Fig. 4.—Pin Rest.

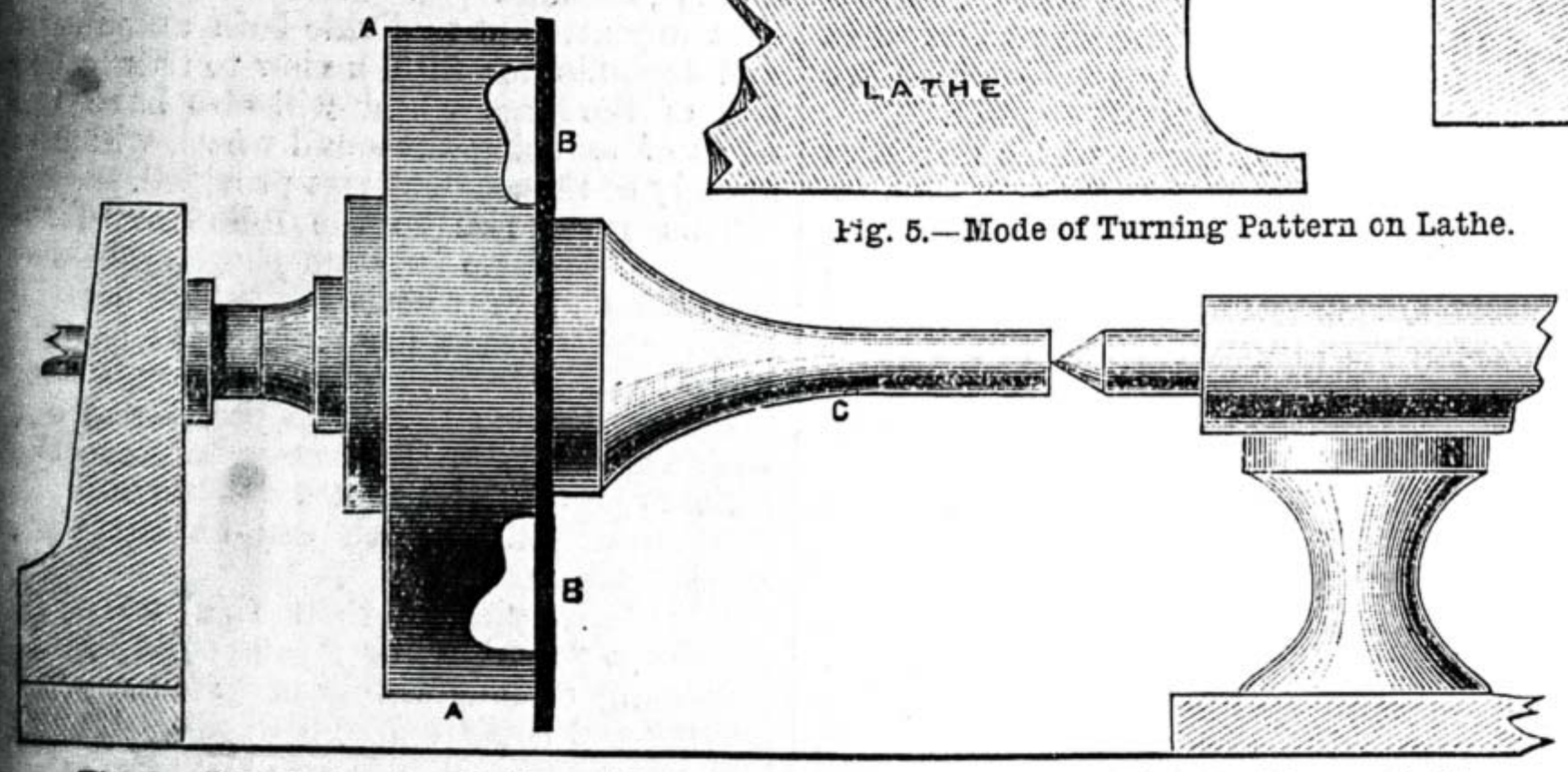

Fig. 3.—Sketch showing Pattern (A), Sheet Metal (B), and Holder (C) in Position on Lathe.

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little under the centre; next get a piece of suet from the butcher's, and as the lathe revolves hold it against surface of metal sheet so as to well grease it. Suet is preferable to oil, as the oil would fly off and dirty everything about the place; now put a pin into one of the holes in rest, and placing the tool on the rest, and against the *left* side of pin, press firmly against the metal as it revolves. The tool in this case becomes a lever, and the pin the fulcrum, allowing you to exert a great pressure against the metal, which is required in brass or other hard metal. The grease forms a lubricant, reducing the friction to a minimum. Working always from the *centre*, you will see the metal gradually give way and conform itself to the shape of the pattern. When you have got the metal well home to the pattern, cut off the superfluous metal with an ordinary V-tool used for metal, and make the edge round and smooth with emery paper. Clean and polish the surface with fine flour, emery, and oil, finishing off with whiting and water; now remove the retaining block and polish the flat part. The metal tray will not come off yet, as the heat engendered will have made the resin stick inside, and you may have to make metal hot to get it off pattern, which you can do by unscrewing chuck of lathe, and hold the metal tray over a gas flame. You can take off the resin with boiling water. The tray is now finished and can be chased, or a design worked on it by repoussé work, just as the fancy of the workman may lead him to prefer. Of course there is no limit to the number of articles which can be made from the same mould or pattern. In real practice the patterns are made in brass or iron, as the extreme pressure used tends to destroy the shape of a wood mould. In our next we shall try something a little more difficult—an inkstand and a circular box with lid.

SOME NOTES ON SCREW CUTTING.

BY A WHITWORTH SCHOLAR.

PROBABLY one of the greatest difficulties with which the young mechanical engineer has to contend, is that afforded by the subject of screw cutting. Indeed, not only is the pupil or apprentice often perplexed, but the practical mechanic is also frequently at a loss as to what arrangement of wheels is required in order to cut a screw of a given pitch.

This fact is rendered more noticeable inasmuch as the subject is in reality by no means a difficult one to acquire when once the leading principles involved have been thoroughly grasped. Feeling sure that a large number of the mechanical engineering readers of WORK will have experienced the want of information on this subject, I will at once proceed to place the matter before them in as simple and concise a manner as due regard for accuracy will allow.

The screw-cutting lathe presents a highly interesting example of the important *copying principle* so often employed in engineering tools. The "guide screw," or, as it is sometimes called, the "leading screw," is an accurately finished screw of about the same length as the lathe bed, and placed exactly parallel to the centre line of the lathe. Upon the exactness of this leading screw depends the accuracy of all screws cut in the lathe; hence the necessity for carefully protecting from injury this most important part of the machine. The pitch of the leading screw—that is the length occupied by a thread and a space—is usually $\frac{1}{2}$ inch or $\frac{1}{4}$ inch; or the screw is said to have two or four threads per inch, as the case may be; the former being generally adopted in large lathes and the latter in the smaller sizes.

A progressive set of change wheels is also supplied, the smallest of which has usually 20 teeth, and the largest 120 teeth, the intermediate sizes varying by 5 teeth. There are generally two wheels of the same size in the set, as two of 90 teeth, and sometimes also two of 25 teeth. Additional wheels of 130, 140, and 150 teeth are occasionally included in the set; but usually the 120 wheel is the largest.

It is scarcely necessary to state that one end of both the guide screw and the lathe spindle or "mandrel" project beyond the end of the lathe bed, and that the extremities are arranged to receive any of the 22 change wheels. To enable us to communicate motion between the mandrel and the guide screw, an adjustable quadrant is provided which contains a stud or pin, upon which another wheel can be placed so as to "gear" with both the wheel on the mandrel and with that on the guide screw.

Now suppose we place one of our two 90 wheels upon the mandrel and the other on the screw, communicating the motion between the two by means of an intermediate wheel of convenient size placed upon the stud in the quadrant. Then for every revolution of the mandrel, it is clear that the guide screw will also make one revolution, and a moment's consideration will show that the pitch of the screw cut by such an arrangement will be exactly similar to that of the guide screw. The whole problem of screw cutting can, in fact, be resolved into the question of the relative velocities of the lathe mandrel and leading screw, and we will now proceed to consider the means whereby desired variations in this relative velocity may be effected.

In the first place it is necessary to remark that the wheel placed upon the mandrel is a *driving* wheel, that upon the guide screw is a *driven* wheel, and the intermediate wheel which connects these two is called a *stud* wheel; the whole system as described being known as a single train of wheels, to distinguish it from the arrangement known as a double or compound train, to which we shall presently have occasion to refer.

The axiomatic principle which underlies all problems in screw cutting may thus be stated:—The number of teeth in the driving wheel must bear to the number of teeth in the driven wheel, the same proportion that the number of threads per inch in the guide screw bears to the number of threads per inch in the screw to be cut. This consideration is the foundation of—

Rule I.—To find the wheels to cut a thread of a finer pitch than the guide screw:—Place the number of threads per inch in the guide screw for a numerator, and the number of threads per inch in the screw to be cut for a denominator. Add a cipher to each, and we have the required wheels. Thus supposing the guide screw has two threads per inch, and that we wish to cut a screw of three threads per inch, then—

$$\frac{\text{Number of threads in guide screw}=2 \text{ adding ciphers}}{\text{Number of threads in screw to be cut}=3} \left\{ \begin{matrix} 20 \\ 30 \end{matrix} \right.$$

that is, the wheels required are of 20 and 30 teeth.

As a beginner might have some confusion in his mind as to which wheel is to be placed on the screw, and which on the mandrel, I may mention that such a doubt may easily be dispelled by remembering that if the screw to be cut is of finer pitch than the guide screw, the smaller wheel is the driver, and must therefore be placed on the mandrel. But if the screw to be cut is of coarser pitch than the guide screw, the positions are reversed, and the small wheel is then placed upon the guide screw.

It is necessary to observe that it is the *relative* and not the *actual* number of teeth which is the important requirement. As a consequence of this, both the numbers of teeth as found by Rule I. may be multiplied by any suitable common multiplier, or divided by any suitable common divisor, without affecting the resulting pitch of the screw. This fact is often of very great service, since wheels which are of inconvenient size may thus be replaced by those of more suitable dimensions.

For our next example we will take a case in which the number of threads to be cut is uneven, as:—Required the wheels to cut $3\frac{3}{4}$ threads per inch; guide screw 2 threads per inch.

Proceeding as directed by Rule I. we have

$$\frac{\text{Number of threads in guide screw}=2}{\text{Number of threads in screw to be cut}=3\frac{3}{4}}$$

and in this form we cannot add the ciphers as directed. In order to proceed we must first reduce the expression to a simple fraction, and for this purpose we multiply both numerator and denominator of the fraction by the denominator of the fraction belonging to the mixed number, in this case, 4. Thus $\frac{2 \times 4}{3\frac{3}{4} \times 4} = \frac{8}{15}$. Adding ciphers we have $\frac{80}{150}$ as the wheels. As, however, the largest wheel in the set has only 120 teeth, we may conveniently divide this result by 2, and we shall then have 40 and 75 as the wheels required.

The size of the intermediate wheel is immaterial in all cases of single train gear, convenience of communicating the motion between the driving and driven wheels being the only consideration.

Let us next endeavour to find the wheels to cut a screw of 14 threads per inch, with a guide screw of 2 threads per inch, and the smallest and largest wheels having 20 and 120 teeth respectively. Proceeding in the usual way we have $\frac{2}{14}$, which, by adding ciphers, becomes $\frac{20}{140}$. Here we see at once that any attempt to divide both numerator and denominator with a view to reduce the size of the large wheel will also have the effect of reducing the small wheel, which is already of the smallest size provided.

This gives rise to the following statement:—The ratio between the largest and smallest change wheels multiplied by the number of threads per inch in the leading screw will give the greatest number of threads per inch that it is possible to cut with a single train. In the case before us the ratio is $\frac{120}{20}=6$ and $6 \times 2=12$ threads as the finest pitch which can be cut with single train.

For finer pitches than this we shall require a "double" or "compound" train consisting of four wheels, of which two are driving and two are driven wheels. One of the driving wheels is placed upon the lathe mandrel, as in the single train, but it now gears directly with one of the driven wheels, which together with the second driver is fixed to a socket, turning on the adjustable pin in the quadrant; the second driver gearing directly with the second driven wheel which is placed upon the guide screw.

Perhaps the most satisfactory method of finding these four wheels is the following:

Rule II.—To find the four wheels necessary to form a double train. Proceed as in

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Rule I., and assume, in conjunction with the pair of wheels thus found, two equal wheels of convenient size. Then divide the driver or driven of the one pair and the driven or driver of the other pair by any suitable number.

To make this clear, let us take the foregoing case in which the single train failed. We have here $\frac{20}{140}$, and assuming two equal wheels of 100 teeth in connection with these, we then have $\frac{20}{140}\ \frac{100}{100}$, and dividing both the first driven and the second driver by 2, we obtain $\frac{20}{70}\ \frac{50}{100}$ as the wheels required. Either of the driving wheels—the 20 or the 50—may be placed upon the lathe mandrel, and either of the driven wheels upon the screw, without affecting the result.

It not unfrequently happens, especially in the case of screws coarser than the guide screw, that the pitch of the screw is given instead of the number of threads per inch. Suppose, for instance, we require to cut a screw of $\frac{7}{8}$ inch pitch—that is, a screw in which a thread and a space together occupy $\frac{7}{8}$ inch in length. This can be done most conveniently by—

Rule III.—To find the wheels to cut screws of a coarser pitch than the guide screw. Multiply the required pitch in inches by the number of threads per inch in the guide screw, and then add ciphers as in Rule I.

Thus $\frac{7}{8} \times 2 = \frac{14}{8}$, or by adding ciphers $\frac{140}{80}$ and dividing by 2 we have $\frac{70}{40}$ as the wheels required.

Again, supposing the pitch of the screw required is $6\frac{3}{4}$ inches, $\frac{27}{4} \times 2 = \frac{54}{4}$, adding ciphers $\frac{540}{40}$, and assuming two additional wheels of 120 teeth, we have $\frac{540}{40}\ \frac{120}{120}$; then dividing the first driver and second driven by 6, we obtain $\frac{90}{40}\ \frac{120}{20}$ as the required wheels.

In all the examples hitherto given we have dealt with right-handed screws, of which the guide screw affords an example. If a left-handed screw has to be cut, it will be necessary to interpose a wheel of convenient size between a driving and driven wheel after determining the required wheels as before. An extra adjustable pin is provided in the quadrant to carry this additional wheel.

Rule IV.—To prove the wheels to be correct:—Multiply the driving wheels together and multiply the driven wheels together. Divide the greater quotient by the less. Then this result is to be multiplied or divided by the number of threads per inch in guide screw, according as the screw to be cut is of finer or coarser pitch than the guide screw. The final answer should give in the first instance the number of threads, and in the second instance the pitch of the screw to be cut.

To render this clear, we will prove the wheels in the examples given to illustrate Rules II. and III. In the first case we have $\frac{20}{70}\ \frac{50}{100}$ as the wheels. Multiplying the drivers together, $20 \times 50 = 1{,}000$; multiplying the driven together, $70 \times 100 = 7{,}000$; dividing the greater by the less $\frac{7000}{1000} = 7$; and multiplying by number of threads in guide screw, since the screw is of finer pitch than the guide screw, we have $7 \times 2 = 14$ = the number of threads required.

In the second case (Rule III.) we have $\frac{70}{40}$ as the wheels, and we can at once divide the greater by the less, thus:—$\frac{70}{40} = 1{\cdot}75$. But as in this case the screw to be cut is coarser than the guide screw, we must divide by the number of threads in the guide screw, and we then have $\frac{1{\cdot}75}{2} = {\cdot}875 =$ $\frac{7}{8}$ inch as the pitch which would be cut by such arrangement.

In the last case we have $\frac{90}{40}\ \frac{120}{20}$ as the wheels. $\frac{90 \times 120}{40 \times 20} = \frac{10800}{800} = 13{\cdot}5$. Dividing by the number of threads in the guide screw we obtain $\frac{13{\cdot}5}{2} = 6{\cdot}75 = 6\frac{3}{4}$ as the resulting pitch in inches.

I have thus endeavoured to indicate the principles involved in screw cutting rather than confine myself to mere statements of hard and fast rules. For by this means the student or the workman will be enabled to understand whatever theory is involved in the practice of the workshop, and the application of which he will then be in a position to modify or extend.

THE SPEAKING TELEPHONE AND MICROPHONE.

THEIR CONSTRUCTION, AND HOW TO USE THEM.

BY WILLIAM DUFF.

THE speaking telephone is without doubt the most wonderful invention of the nineteenth century. Its usefulness for business purposes is beyond question. It has in a great many instances made its big brother, the "electric telegraph," stand aside. And yet it is so simple in construction that any schoolboy, with a few simple tools, and the merest trifle of mechanical knowledge, can easily put it together.

It consists essentially of a wooden or ebonite case, being hollow throughout its entire length, a round steel bar magnet fitting into the case, having a small bobbin of very fine silk-covered copper wire surrounding its north pole, which is placed at the speaking or hearing end of the case. Directly over the bobbin is placed a circular disc or plate of thin sheet iron, fixed round its edge, but free to vibrate at its middle.

The ends of the coil of wire on the bobbin are connected by two wires running the length of the case, ending in terminals or binding screws, for the purpose of connecting the instrument with the line wire.

Formerly, two such instruments were simply joined up to the line and the earth, as shown in Fig. 2, and no battery was employed, for on speaking into the mouthpiece of one, the vibrations of the voice bent the iron plate to and fro in front of the magnetic pole, and thus by magneto-electric induction set up undulatory currents of electricity in the little coil around the pole. These currents were of a strength and form dependent on the vibrations of the voice, and after travelling along the line they passed through the coil of the receiving instrument, where, by a reverse action, they set the iron plate into a vibration sympathetic with the vibration of the plate of the transmitting instrument. The result was that an ear placed at the mouthpiece of that instrument could hear a feeble imitation of the distant speaker's voice. I can well remember the first time I heard a telephone speak. It was then only in the experimental stage. The instruments were the property of Sir Wm. Thomson. When I placed the instrument to my ear, at first, I was so much excited I could hear nothing, but gradually the tones of a well-known voice became recognisable, and when I laid down the instrument, I resolved to set at once to work and make for myself a set of this wonderful apparatus. It was not until long after, however, that I did actually make a beginning, and I have now a pair of as good telephones as any one could desire.

I had a little knowledge of the science of electricity, and knew something of the why and wherefore of certain laws which govern things electrical, so I made my telephones to please myself. I had no figures or diagrams to go by, save an advertisement cut of the Religious Tract Society.

I will set out the details of one of these instruments, hoping to make them plain enough to the ordinary reader, and if any electrical engineer happens to come across this description I hope he will wink at any miscalculations he may find; and should he be inclined to find fault, I will ask him to remember that I am not writing for him. But at the same time, let me assure the amateur that if he follows my directions he will not need to be ashamed of the telephones, for mine *can* speak, and speak well, and the best instrument that ever left the electrician's workshop can do no more.

The outer case then, to begin, is made of mahogany, and is in three pieces, which I will call the body, the mouthpiece, and the cap. The body will be easier to make in two pieces, for if made solid or in one piece it will be very difficult to drill the hole for the magnet. Get two pieces of mahogany, 4 in. by 2 in. by $6\frac{1}{2}$ in., and fasten them together in the usual way for turning—*i.e.*, plane two sides and glue them with a piece of soft paper, such as newspaper, between. They will have the appearance of one piece, measuring 4 in. by 4 in. by $6\frac{1}{2}$ in. Turn them any shape you fancy; but that shown at Fig. 3 will suit the purpose. Make the cavity at the end the sizes indicated in the figure, viz., $2\frac{3}{4}$ in. by $\frac{1}{2}$ in. When you have the body turned and finished, split it (the paper between the halves makes this easy), and make the hole for the magnet with a gouge, taking care to have it in the middle of the entire piece. The hole should be made so that the magnet will fit well and not rattle about; but it must not fit too tight, so as to prevent easy adjustment. Turn the mouthpiece out of a piece of the same stuff as the body, measuring 4 in. by $\frac{3}{4}$ in. Fig. 10 gives the exact sizes to which it must be turned. The cap is shown at Fig. 5; but it can be dispensed with, without in any way lessening the effectual working of the instrument. The bobbin to take the wire for the coil is also of wood, preferably boxwood, and it will require some care in turning, for it is so small and so thin in every part that it will be easily broken. It can be made of paper, with pasteboard ends. I made mine thus: a narrow strip of cream laid paper, glued and rolled round the magnet several times till about $\frac{1}{8}$ in. thick, and two round discs of thin pasteboard, with holes, the width of the magnet, glued at each end of the paper. Fig. 7 shows it in section, and the proper sizes are given, which must be the same whether made of paper or wood.

The wire for the coil is No. 36, silk-covered; about $\frac{1}{4}$ oz. will be sufficient. It should be wound on the bobbin as evenly as possible, and free from kinks; both ends must be left free for connecting up; one end taken through the side of the bobbin, and the other one left where the winding stops. After winding steep the coil in melted paraffin wax. In winding the coils for the pair of instruments one will have to be wound in the contrary direction to the other, and in joining up, the beginning of the one and the end of the other must be connected together.

The ends of the coil are soldered to two

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stout copper wires, and carried inside through holes to the top of the case, and fastened to binding screws. The diaphragm is a thin ferrotype plate, to be procured at a photographic apparatus shop; cut it 3 in. in diameter, and don't have any wrinkles in it, especially round the edge. After all the pieces have been made and fitted, the best means to put them together will be to begin by gluing the two halves of the body. Previous to this have the two small holes to take the wires from the coil running parallel to the large hole for the magnet, one on each side. When dry and hard put the magnet in place, with its south pole at the top, and insert the adjusting screw, which should have a neck to work in a little collar screwed to the end of the body (see Figs. 4 and 8). Screw and collar should be of brass. Push the wires from the ends of the coil through the small holes in the body, and bring them out at the top; place the hole of the bobbin on the protruding end, the north pole of the magnet; the bobbin should fit tightly; it will be held in position by the wires, which may now be fastened to the binding screws at the top; turn the end of the wire two or three times round the stem of the screws; screw them tightly into the wood. The diaphragm may now be laid in its place; but just before doing this place a piece of paper over the magnet, and with the adjusting screw bring the magnet to touch the paper; place the mouthpiece over all, and fasten with four brass screws; before fastening up tight withdraw the paper; this will leave a space of about a 32nd of an inch, or the thickness of the paper, between the magnet and the diaphragm; the mouthpiece clamps it round the edge, and leaves it free to vibrate at the centre. The magnet, it should be said, will require no further adjustment. It should be strongly magnetised to begin with, and capable of sustaining its own weight.

The instrument just described is what is known as the Bell receiver, and two of these instruments will speak or hear if they are alternatively held to the mouth or ear. The method of connecting them to the line is already described.

There are a great many different telephones in use, and a great many more have been invented that will never be in use. They are all dependent, more or less, on the same principle.

After the invention of the telephone, Professor Hughes, of telegraphic fame, invented an instrument known as the microphone. He had been investigating acoustical phenomena by the aid of the telephone, and discovered that a delicate contact between two conductors could be made to transmit speech. In the course of his experiments he had been using a strained wire, when suddenly the wire broke, causing a great rush of sound to be heard in the telephone which he held at his ear. He sought to imitate the condition of the wire at the moment of rupture by replacing the broken ends and pressing them together. This he did with three common nails; two joined to the ends of the wire lying on the table side by side, and the other lying across them. The effect was improved by building the nails up log-hut fashion. This crude apparatus reproduced sound with remarkable fidelity. Acting on the facts brought out by these experiments, he devised an instrument for magnifying weak sounds, which he called a microphone.

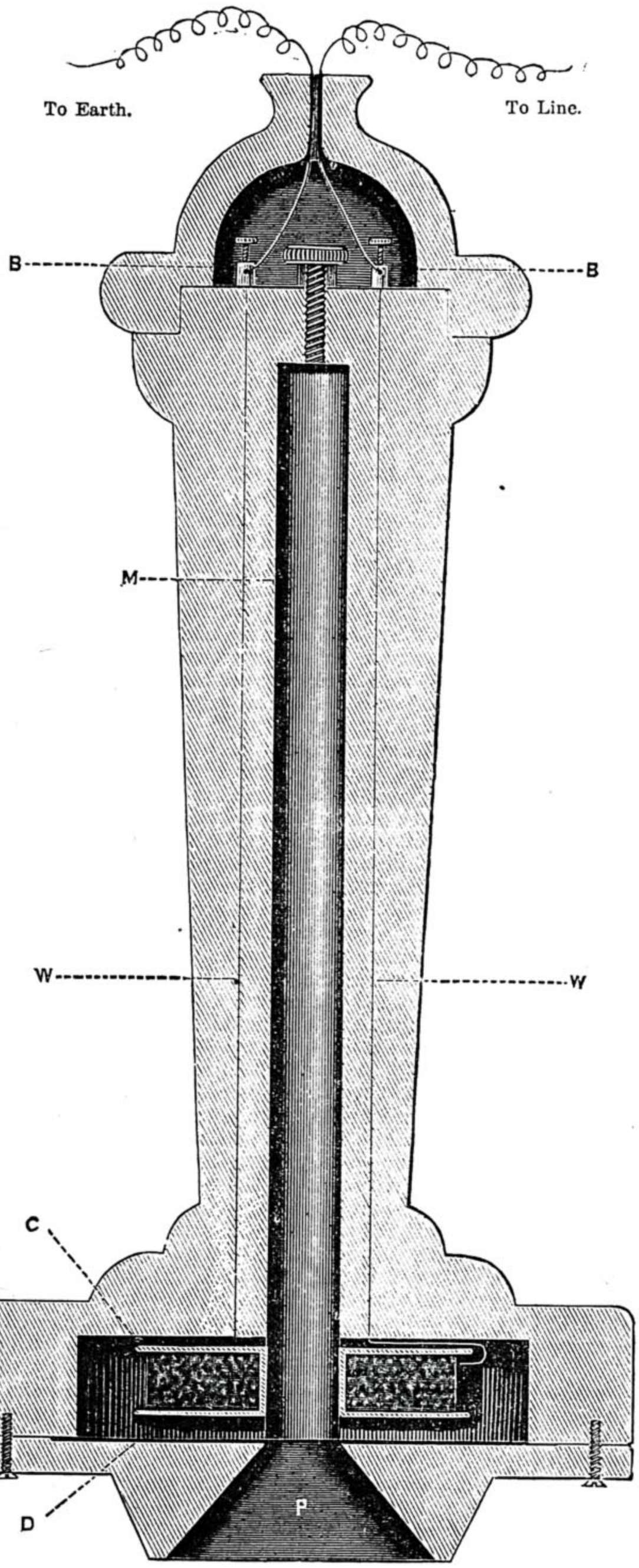

Fig. 1.—Section of Bell Telephone Receiver, of which the Outer Case is of Mahogany or Ebonite.

M, Magnet fitted with Adjusting Screw. C, Coil of Silk-covered Wire. W, Wire from Coil to Binding Screws. D, Diaphragm of Ferrotype Iron. P, Earpiece.

As he made it, it consisted of a lozenge-shaped piece of carbon one inch long, a quarter of an inch wide at its centre, and one-eighth thick. The lower end rested as a pivot upon a small block of similar carbon, the upper end being made round, so as to play free in a hole in a small block of carbon similar to that at the lower end. The lozenge stood vertically upon its lower support.

The form of the carbon is not of importance provided the weight of the upright contact is only just sufficient to make a feeble contact by its own weight. Carbon is used in preference to any other material, as its surface does not oxidise or rust. The general appearance of the microphone will be seen from the drawing, Fig. 6, and the method of connecting it to the line and battery will be understood by reference to the section given at Fig. 11.

This instrument is capable of detecting very weak sounds made in its presence. If a pin, for instance, be laid upon or taken off the table, a distinct sound is emitted; or if a fly be confined in a matchbox, or other suitable prison, it can be heard walking with a peculiar tramp of its own. Thus, the beating of a pulse, the ticking of a watch, the tramp of a fly, can be heard at least a hundred miles distant from the source of sound. The success of the telephone is largely due to the microphone, for the transmitters which are now in use, in conjunction with the telephones, on our exchange systems are, to a great extent, modifications of Professor Hughes' simple contrivance.

When a microphone is used a battery will be required to generate a current. For the fly-walking and watch-ticking experiments a sufficient battery can be constructed for little cost. The following will suit all requirements; it is a modification of the Daniell cell. Three jam pots, three plates of copper, with a gutta-percha-covered wire soldered to each; three plates of zinc, with a copper wire also soldered to each, which may be bare; a few grains of bluestone (sulphate of copper), a little sawdust, and some salt and water. These are all the materials necessary. Put a plate of copper at the bottom of each jam pot. Allow the wire to come up the side; put a little of the sulphate of copper on the top of each plate; pack in the sawdust until a few inches from the top of the pot; place a sheet of zinc on the top of sawdust; allow the wire to come to the opposite side of the pot

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from that where the wire from the copper plate comes; moisten the sawdust with the water in which the salt has been dissolved; a cork may be fitted to each pot to keep them clean and tidy. Connect the cells together as in Fig. 9.

With this arrangement speech can be carried on, and a great number of wonderful experiments conducted. To have a direct communication between two stations a duplex set of apparatus will be required, including call-bells, etc., mounted upon a switch-board, with all the paraphernalia of practical telephony; but as these do not come within the scope of the present paper, I will leave them to some future time. Perhaps an abler pen than mine may write upon this subject. At all events, I have endeavoured to do my best to put the matters of principle and construction plainly and clearly before the reader, and I hope I shall have succeeded not only in doing this, but in interesting many in a subject which is possessed of considerable importance.

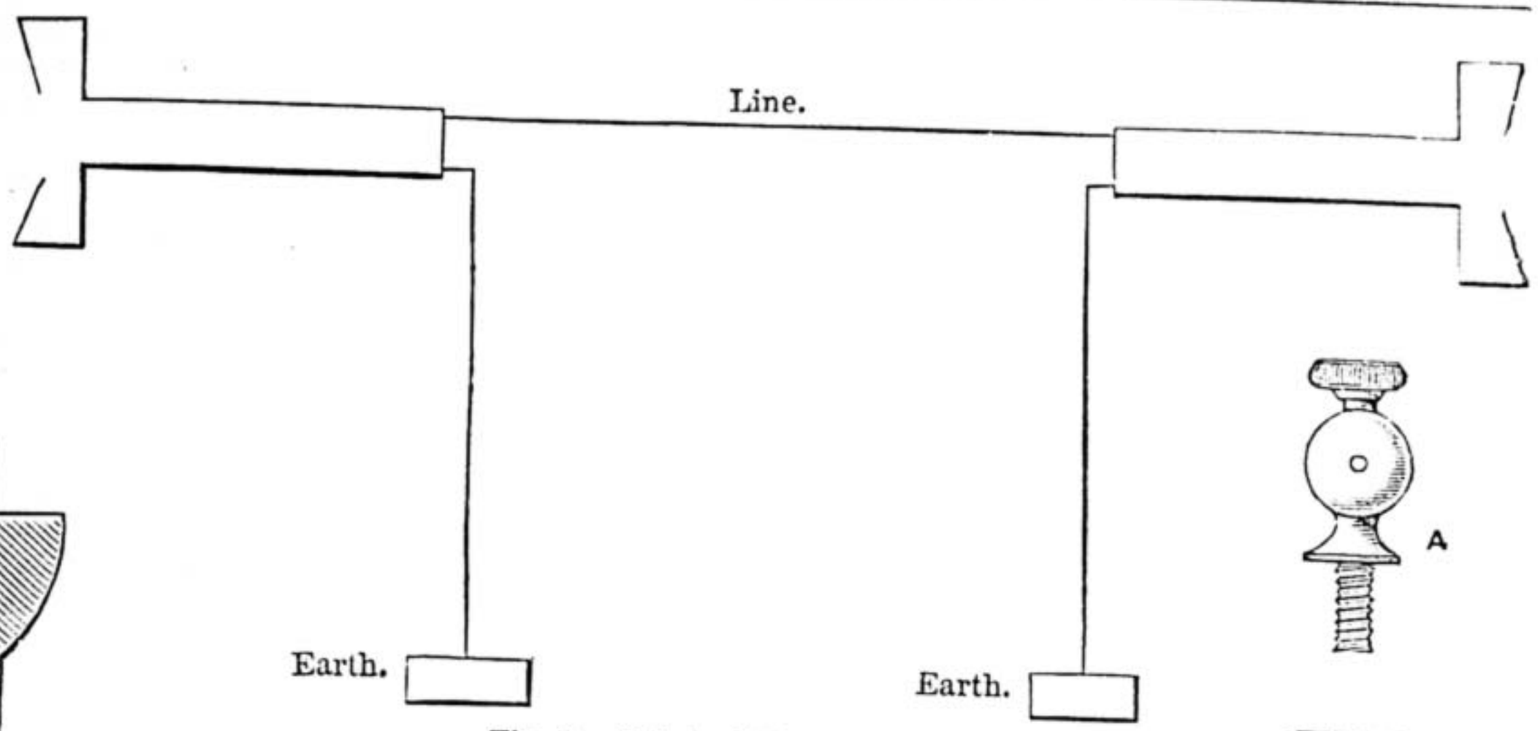

Fig. 2.—Original Form of Telephone.

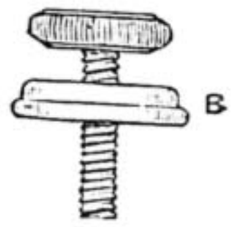

Fig. 4.—Binding Screw (A) and Adjusting Screw (B).

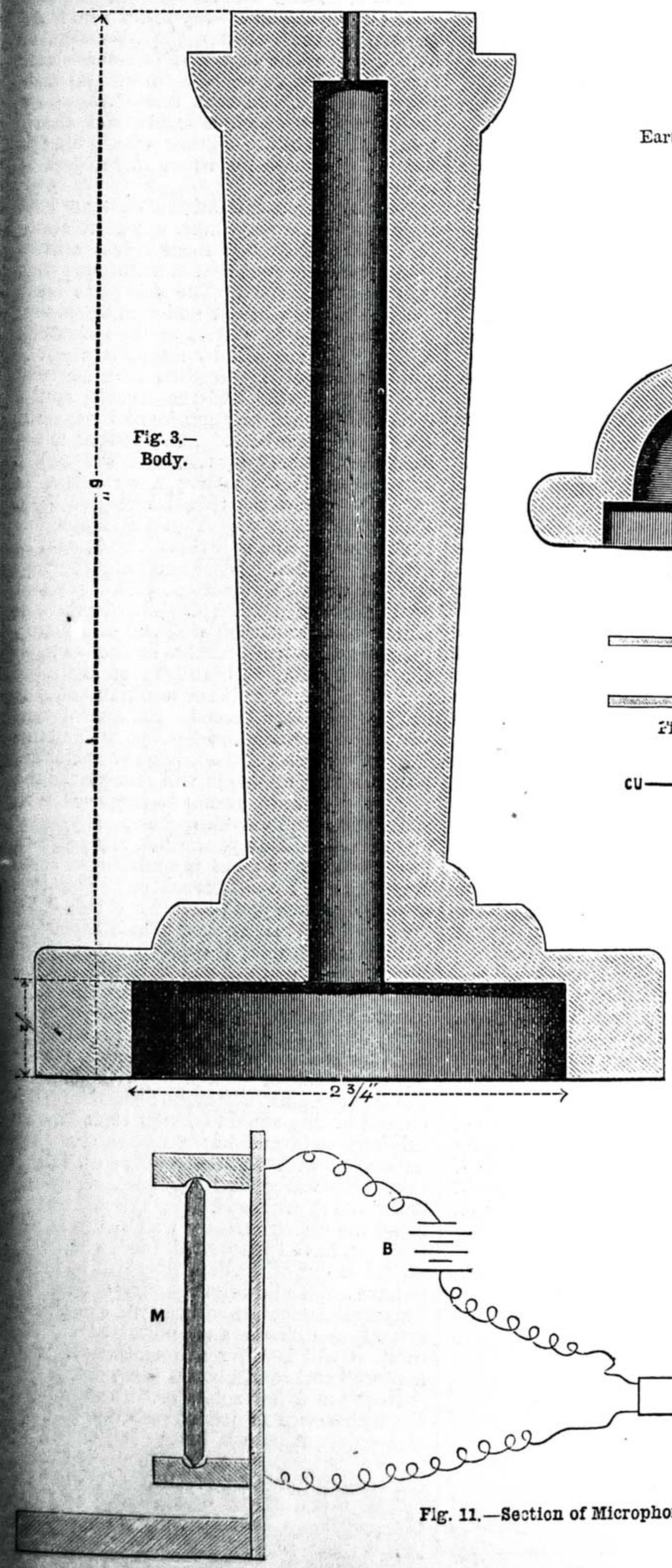

Fig. 3.—Body.

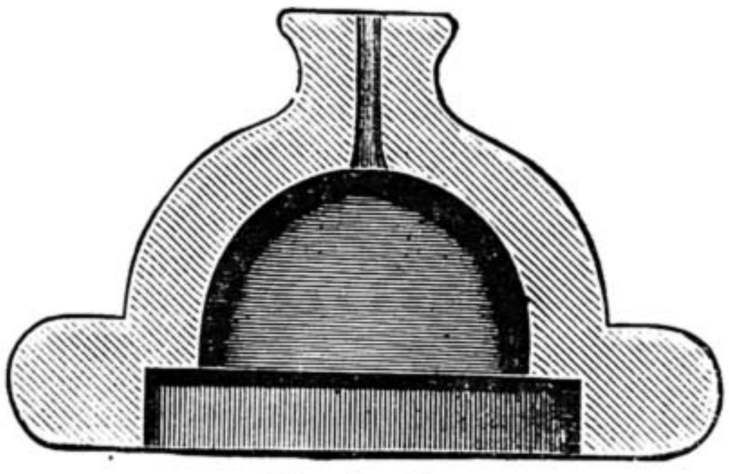

Fig. 5.—Cap.

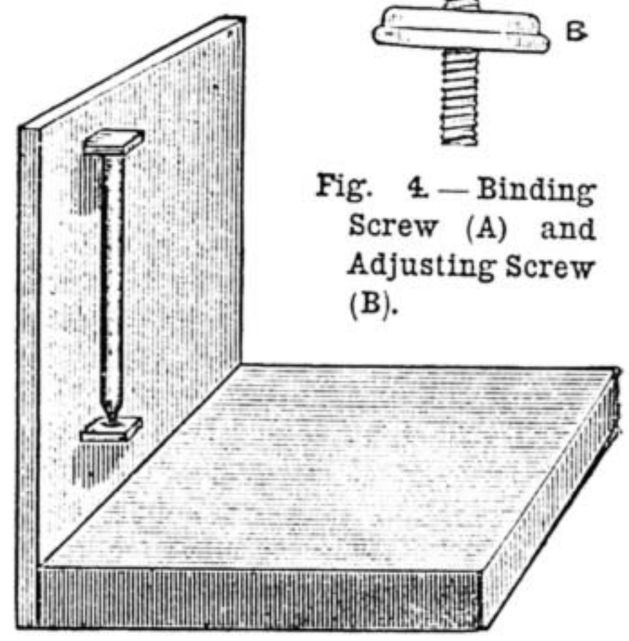

Fig. 6.—Carbon Microphone.

Fig. 7.—Bobbin for Coil.

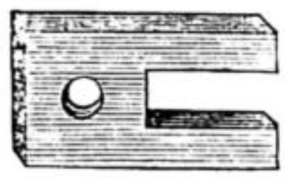

Fig. 8.—Collar.

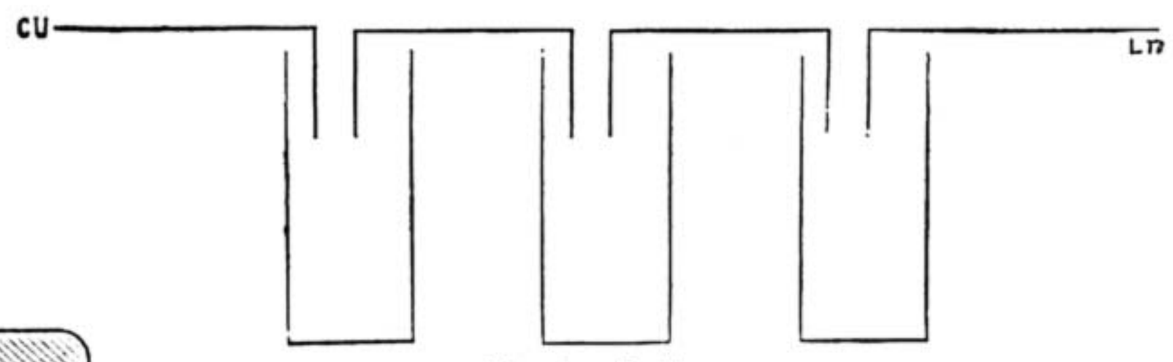

Fig. 9.—Battery.

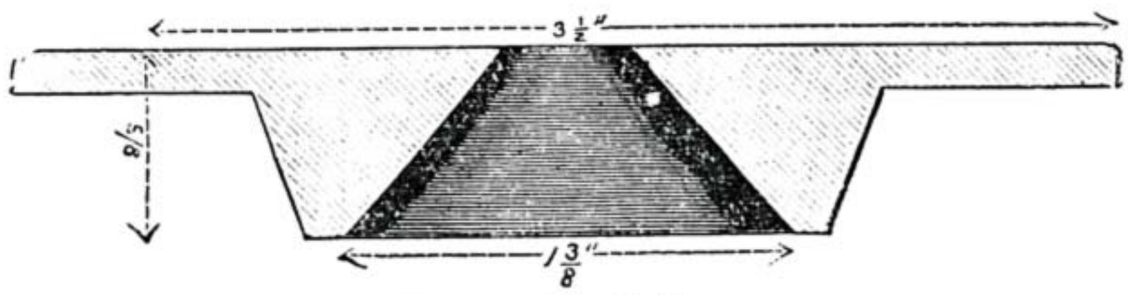

Fig. 10.—Mouthpiece.

Fig. 11.—Section of Microphone.

CONSTRUCTION OF BOTTLE BICHROMATE BATTERIES.

BY F. W. MASON, F.S.S.

As many amateurs, and likewise professional men, use these in their experiments, it would perhaps not be out of place for some to know how to construct them. These bottle batteries, though generally known by the name of "Bottle Bichromate Batteries," may really be used with any single fluid cell solution; and at the conclusion of this article I will give a few different kinds of solutions which have been practically tested and used for some time past both by myself and many leading electricians.

In the first place take any ordinary wide-mouthed bottle. If it be preferred to use the regular form, bottles can be obtained at any electrician's for about 9d. or 1s. each. They should have the capacity of about one pint. Of course smaller ones can be used if desired, but this size is the one I always recommend. Take a piece of ebonite, or any hard wood, about $\frac{1}{4}$ in. or $\frac{1}{2}$ in. thick, and, by means of cutting and turning it in a lathe, obtain it so that it will just fit loosely inside the neck of the bottle; then take another piece of similar material, about $\frac{3}{16}$ in. thick, and turn this slightly larger than the neck of the bottle, so that it will, when placed on the top of the bottle, rest there without in the least entering the neck. Put these two pieces together by means of glue, so that their centres exactly coincide with each other. Thus we shall have our lid made. When these are dry and firm, drill a hole through the centre about $\frac{1}{4}$ in. diameter; then fit through this, by means of marine glue, a piece of brass tube $\frac{3}{16}$ in. diameter. This should project about 1 in. above the lid, and about $\frac{1}{8}$ in. underneath; it should also have in it, at the upper extremity, a hole drilled and tapped, and a screw fitted to it. This is for the purpose of holding the brass rod (which is attached to the zinc element) in any position.

Having done this, the next step is to take a piece of zinc $\frac{3}{16}$ in. thick and of a suitable size so that it will go through the neck of the bottle into the interior; then drill in this (at the end which is designated to be that which is to be connected to the brass rod) two holes about $\frac{1}{8}$ in. or $\frac{1}{4}$ in. from each end. Then take a strip of ebonite $\frac{1}{2}$ in. thick by (if the zinc is, say, 3 in. broad) 3 in. long and $\frac{1}{4}$ in. width; cut a channel in this about $\frac{1}{4}$ in. or $\frac{3}{8}$ in. deep to receive the zinc (the width to be regulated according to the thickness of the zinc employed); two holes are then to be drilled at each end so as to be level with those holes drilled in the zinc, and by means of two small screws the zinc and the ebonite strip can be attached together. The ebonite strip should also have in its centre another hole drilled and tapped about $\frac{1}{8}$ in. diameter.

Having done all this, next take a piece of brass rod $\frac{1}{8}$ in. diameter, tapped at one end so as to screw into the ebonite strip; pass one end of the rod through the brass tube in the lid, and we have the zinc element complete (except the amalgamation). Then attach to the lid, by means of very small screws, a U-form piece of copper so as to encircle the brass rod without touching it. It should leave a space of $\frac{7}{16}$ in. between the edge of the copper and the brass rod. This copper strip should be about $\frac{1}{16}$ in. thick, and should also be attached to a terminal on the lid. It is to this copper strip that the carbon element is joined (one on each side of the zinc).

When we have got this into its place and properly fixed, we can then choose our carbon plates. These should be made of good hard porous carbon, exhibiting no cracks or coloured marks whatever on its surface. They should, of course, be of such a size as to suit the cell itself; they should reach from the lid to within $\frac{1}{4}$ in. from the bottom, and should be, at least, the same size in width as the zinc plate. Before we can attach our carbon plates to the copper strip we shall have to copper one of the ends of each; and to do this we shall have to make use of the electro-plating process. Take any wide jar holding about a pint, and nearly fill it with the following solution:—Copper sulphate, 1 lb.; dissolve in hot water, and add, when this is cold, 9 oz. of strong sulphuric acid. Be careful in the adding of this, as it will cause the liquid to become hot and spirt; it should be added very slowly. If the reader should not like to make up a quantity of this, he can use the following smaller proportions:—Copper sulphate, 2 oz.; sulphuric acid, 1 oz.; water, one pint.

When we have obtained our solution, and have filled our jar with it, we must obtain a cell of some kind of battery. The Bunsen is very good here; or, if the reader has a Daniell, he can use it in place of the Bunsen. If we have the Bunsen, attach a wire to the zinc, and also one to the carbon plate, and bring them to our jar of copper solution. To the wire coming from the carbon of the battery attach a piece of copper plate, and immerse in the jar of solution; string the carbons to be coppered to the other wire coming from the zinc of the battery. They should be attached to this wire by means of thin copper wire. Immerse the ends of the carbons in the jar of coppering solution to about the depth of 1 inch. Be sure that the carbons and the copper plate do not touch. Leave them in for about one or two hours (according to circumstances), and in about that time we shall find we have a fine firm coating of copper deposited upon them. Then swill these well in cold water, and wipe.

Having done this, the next procedure is to prepare a bath of wax: take an old tin tray about 2 in. deep, and put some good paraffin wax in it, and apply a source of heat (as gas) underneath. Fill this tin up with melted wax, and regulate the heat so that it will just barely keep the wax boiling; then immerse the coppered ends of the carbons in this for about 2 inches. Allow these to remain in for twenty or thirty minutes. Then take out and well wipe with dry cloths. Be careful and well wipe the coppered ends, or else it will be found that we shall never obtain the solder to stick to them; and it must be also understood that the waxing of the carbons must *always* take place *after* the coppering and never *before*, because if the carbons were waxed first we should never obtain a good coating of copper on them, and it is for this simple reason they are waxed afterwards. The waxing is to prevent the salts of the battery solution creeping up and destroying the connection. When we have well wiped and again washed our zincs in water, we can attach them to the copper strip by means of soldering the copper strip to the coppered ends of the carbon. Use ordinary solder and spirits of salts, and well wipe and wash the joint afterwards. Many electricians prefer to use resin for these joints; but I should not advise any of my readers to use it, unless they have the patience of Job, a good temper, and also have had a little experience of using resin with solder. I never use resin in any of my apparatus, and I have never had any fault to find with any of it yet. When we have finished our carbons, we have the battery complete, except the amalgamation of the zinc and the zinc terminal. To make the latter, you can either tap a hole in a brass rod and screw a small terminal in to it; or else, if the battery is for use and not for show, we can drill a small hole down the rod, say for about $\frac{1}{2}$ in., and then drill another hole through the rod, and across this other hole—say about $\frac{1}{4}$ in. from the top of the rod—tap the hole that is drilled down the rod, and insert a small screw. If then we pass a bit of wire through the other hole, and then screw the screw down, we shall have a handy and cheap terminal. It is the method that I always use in similar cases where my object is not show.

Now for the amalgamation of the zinc. This is, in my idea, a very important part. Many seem to think that if there is just a little mercury on the zinc, that is sufficient; but this is *not* sufficient. The zinc plate must have a thorough bright and regular coating of mercury on it. There are two methods of doing this: one is by means of the old troublesome rubbing method with mercury and sulphuric acid, and the other is by the method designed and improved by myself. I will give them both. The one that is the least troublesome to use, and the one I always use, is the latter; nevertheless, as only a very few use this, I will give both. First, the old method:—Take a little mercury in one saucer, and a little sulphuric acid in another; pour a very little sulphuric acid on the mercury. Then, with a piece of rag tied on the end of a stick, dip first in the sulphuric acid, and then well rub the plate; then obtain a few globules of mercury on the plate, and well rub them with the rag till a bright uniform amalgam of zinc and mercury is obtained. Be careful that you do not get the acid on your hands or clothes. If you get the acid on your clothes, a little strong ammonia will remove the red stain, but will not, as may be supposed, turn tailor and mend the burnt hole. If you get any of the acid on your hand, rinse it well in running water; but my advice for these two points is, Do not get acid on your clothes or person unless you possibly can help it.

Second and best method of amalgamation, but slightly dearer; it costs four times more than the old method, and it is this ground that debars many from using it:—Take nitrate of mercury, 1 oz.; chloride of mercury, 1 oz.; dissolve in water to which a little hydrochloric acid and ammonic nitrate have been added; make up with distilled water to one pint. The zincs, before being immersed in this, should be well cleaned with sulphuric acid and water, and should then be swilled with distilled water; or, failing this, with water that has been vigorously boiled and then filtered. I fear I cannot recommend the use of ordinary water as it is. If the zincs have been well cleaned, when they are taken out of the bath they will be found to have a splendid bright coating of mercury. This arrangement, as will be seen, constitutes one of cleanliness and portability. The solution will last for a long time if it is kept well corked in a bottle when not in use.

Now for a few solutions. First of all, the bichromate of potash solution:—Take bichromate of potash, 1 lb.; dissolve in four pints of hot water; allow to cool, and when cold add sulphuric acid, $10\frac{1}{2}$ oz.—This solution is one of the best known, and has been regularly used by me for some years past.

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Chromic acid solution:—Chromic acid, 1 lb.; sulphuric acid, 8 oz.; water, four pints.—Very good, and gives an intense current.

Permanganate of potash solutions:—Mason's solution consists of permanganate of potash, 6 oz.; sulphuric acid, 2 oz.; water, 1½ pints.—Gives a most powerful current for same length of time as bichromate.

Bromine cell.—Same solution as permanganate of potash, with a layer of bromine under the solution. It is the most powerful solution known, giving over 2·0 volts E.M.F., and also having an extremely low resistance. The solutions above given have all been tested for a great number of years, and so can be thoroughly recommended to all those that are in want of a good strong solution. They all give at the least an E.M.F. of 2·0 volts.

Any matters pertaining to batteries I shall always be very pleased to answer. I should have before stated that there could, and should, be run round the lid of the bichromate bottle battery a strip of brass, fitting nicely the outside of the bottle. This sets the bottle off, and makes the job look workmanlike, as all work should that is made from instructions given in WORK.

OUR GUIDE TO GOOD THINGS.

*** *Patentees, manufacturers, and dealers generally are requested to send prospectuses, bills, etc., of their specialities in tools, machinery, and workshop appliances to the Editor of* WORK *for notice in "Our Guide to Good Things." It is desirable that specimens should be sent for examination and testing in all cases when this can be done without inconvenience. Specimens thus received will be returned at the earliest opportunity. It must be understood that everything which is noticed, is noticed on its merits only, and that, as it is in the power of any one who has a useful article for sale to obtain mention of it in this department of* WORK *without charge, the notices given partake in no way of the nature of advertisements.*

88.—HOME ART WORK.

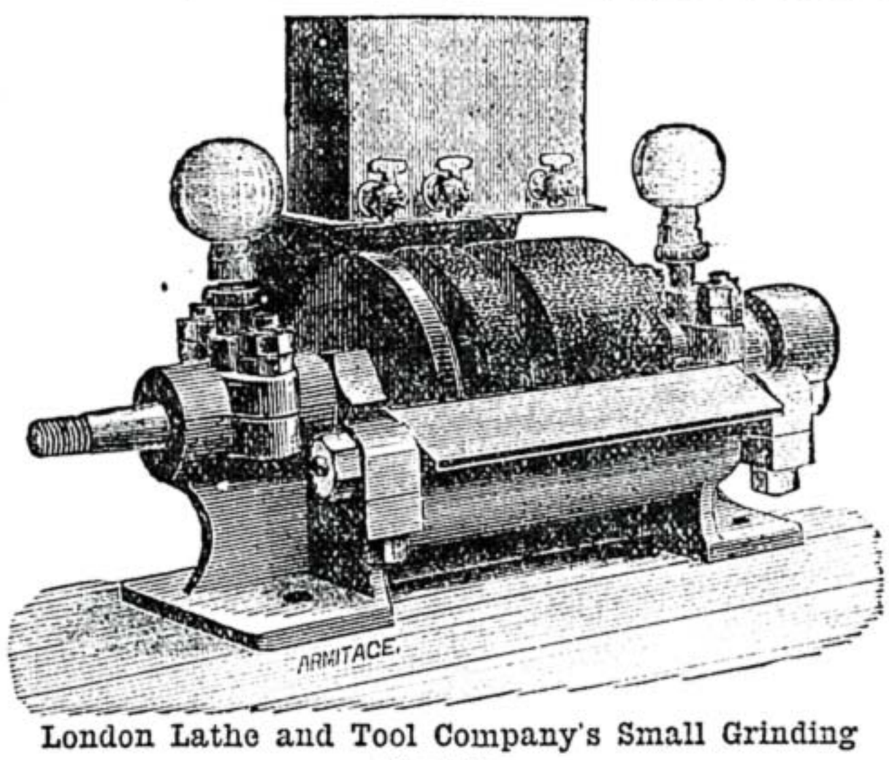
MANY readers of WORK are, without doubt, interested in the employment which is well expressed in the title of the magazine now under consideration, namely "Home Art Work." It is, as the wrapper tells us, the new monthly series of "The Art Designer," and is "A Monthly Portfolio of Full-Sized Designs for Painting and Artistic Work," edited by Mrs. Conyers Morrell, and published at and by Mr. John Heywood, of 1, Paternoster Buildings, London, and Manchester. There is, as a matter of course, much to interest and amuse in the letterpress, but the chief attraction lies in the sheets of designs that are issued with each monthly issue. In the parts before me are two small sheets—one, that is to say, in each part, with some well drawn classical figures from the antique, the most noticeable fault being a somewhat exaggerated gap between the great toe of each foot and the toe next to it, which gives one the impression that the classical figures had originally rejoiced in the abnormal number of six toes in each foot and had lost one of the number by amputation. The larger sheets are very good. One of these has on one side a spirited full-size design by Walter Crane, for the corner of the border of a table-cloth, exhibiting two winged dragons in mortal conflict; and, on the other, designs for glove and handkerchief boxes, adapted for needlework, repoussé work, poker painting, or wood carving, by Mr. G. C. Haite, F.L.S.; a design for a plaque of water lilies, tadpoles, and frogs, by Mrs. Ernest Peel; a border for altar linen by the Rev. Aymer Vallance; a tea cup and saucer, with violas, by E. Hall; and two pincushion needle-boxes, one in the form of a violin and the other resembling a guitar. The other large sheet contains on one side Andromache, reclining on a couch, and on the other the same subject on a small scale, surrounded by a border of flames; various small designs including some Old English patterns for muslin embroidery; two circular designs for needlework or repoussé work for embroidery, the subject being wild boars in some well-conceived scroll work by the Rev. Aymer Vallance, and some seventeenth century designs for gloves useful for painting on needlework. The list of illustrations just enumerated will give intending purchasers a sufficient idea of the nature and contents of this magazine. The large sheets, it may be said, are about four times the size of the small sheets.

89.—HARGER BROTHERS' IVORINE AND VULCANITE.

Messrs. Harger Brothers have sent me specimens of two materials which they have recently added to their large and varied stock of tools, appliances, and materials. They are called ivorine and vulcanite, and, as may be supposed, the former material is of glossy whiteness, and the latter black; the ivorine for fretwork, inlaying, and overlaying in fine work, and is supplied at 2s. 6d. per square foot. The vulcanite is dearer, being 3s. 6d. per square foot, but it is much thicker than the ivorine. Any one who stands in need of them at any time, will find these materials both useful and serviceable for the purposes for which they are supplied.

90.—EXAMPLES OF LATHES, APPARATUS, AND WORK.

This is a very useful pamphlet, by the author of "Lathes and Turning," published by Messrs. E. and F. N. Spon, 125, Strand, W.C. In his preface, the author says: "The following pages are written with a view of describing the construction and capabilities of some of the most recently designed lathes, apparatus, and tools. Those who want further information on the general subject of turning are recommended to read "Lathes and Turning," second edition, published by Longmans, price 18s. The pamphlet is, in fact, an agreeable form of catalogue and price list of the specialities of the London Lathe and Tool Company, many of which were noticed and illustrated in the earlier numbers of this Magazine. Some interesting examples of ornamental turning are engraved, and notably a peculiar specimen of turned work consisting of a cube, having within it a smaller cube, with a horn projecting from each of its sides. This is all turned out of the solid. Ivory or hard wood is the best material of which to make it. Some excellent specimens of geometric turning are also given, which, up to the present time, have been produced only by means of expensive apparatus. The author, however, tells us that he has devised a simple and inexpensive instrument by which this class of work can be executed in a plain lathe, without overhead motion and without division plate. This will manifestly be a great boon to amateurs and others who wish to execute a little ornamental turning of the kind mentioned, but are not possessed of means wherewith to furnish themselves with the costly apparatus that, up till now, has been absolutely necessary. The author of the pamphlet does not tell us what the instrument is, but he refers us to a volume of his "Geometric Turning Simplified," in which all those who want to know how these and other figures can be produced, will find the means of slaking their thirst for knowledge. While writing on this subject, I may call attention to the London Lathe and Tool Company's Grinding Machine, a compact and handy appliance, which has not yet received notice in WORK. "The small cutting tools," says Mr. Northcott, "now used in the best organised workshops, for even tolerably heavy work, are ground far quicker and better by these small tool-grinding machines than by the old-fashioned grindstone, which latter, with its dust, dirt, and disorder, may be relegated to the yard and used only for rough grinding. Unless otherwise ordered, the spindle carries three wheels; the first, a wide and moderately coarse emery wheel for doing most of the work; the second, a fine emery wheel for smooth grinding; and the third, a metal wheel, used with the finest emery or other fine grinding material, for giving the polished edge required by some cutting tools. The spindle end is made to carry a face grinder, buffing wheel, etc. The guide bar or rest in front may be fixed at any angle, and the cutting tool is generally carried by a small adjustable sliding rest, pushed along the guide bar by hand. By these means, all cutting tools may be ground to correct cutting angles, and much better work produced by them than by badly shaped hand ground tools. The grinding machine may be mounted on a bench or upon special stands as preferred." Prices range as follows:—With six-inch wheels, £10; with nine-inch wheels, £15; with twelve-inch, £20. Countershafts complete for each size of wheels are supplied, complete, for £2 10s., £3 5s., and £4 respectively. A representation of this desirable and useful machine is given in the accompanying illustration.



London Lathe and Tool Company's Small Grinding Machine.

This pamphlet, small as it is, for it comprises only forty-eight pages, will, I am inclined to think, give all those who wish to take up ornamental training, and attain proficiency in it, as good an insight into the tools and appliances that are needful and the work that can be executed by them as well as by making reference to, and searching the pages of, many a more pretentious and costly work. At the end of the book are given engravings of many of the simpler varieties of ornamental work produced by many of the lathes and apparatus described in its pages. Although the author speaks of them as "simpler varieties," they present many complex arrangements of curved lines that are almost bewildering in their crossing and recrossing. I believe that all these diagrams are engraved on the wood in the lathe, for they could hardly be produced in all their regularity and intricacy by the artist's pencil and the engraver's graving tool. The pamphlet is appropriately brought to a termination by some specimens of turning in the solid, produced in one of the Company's five-inch geometric lathes by an apprentice who had never before done any ornamental turning. In this page illustration are twenty-five napkin rings of different patterns, most of which were shaped by the Universal Cutting Instrument, aided by the division plate, while some were shaped by one of the Company's Drilling Instruments. I regret that it is not possible to produce here the illustration to which reference is made. I can only hope that a desire to see it, and to judge in some measure of the excellence of the work that is figured, will cause many a reader to send to the Company for a copy of the book itself.

It will be found that some of the appliances described in this pamphlet have been noticed in the earlier numbers of this Magazine, but this need not deter any one who may wish to possess it from sending for it, as the tools and machines which have not been mentioned in these pages considerably outnumber those which have. Added to this there is much information with reference to the uses of the machines that are mentioned which the author of "Lathes and Turning" supplies in an attractive and desirable form.

THE EDITOR.

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SHOP:

A Corner for Those who Want to Talk It.

*** Notice to Correspondents.—*In answering any of the "Questions submitted to Correspondents," or in referring to anything that has appeared in "Shop," writers are requested to refer to the number and page of number of* Work *in which the subject under consideration appeared, and to give the heading of the paragraph to which reference is made, and the initials and place of residence, or the nom-de-plume, of the writer by whom the question has been asked or to whom a reply has been already given. Answers cannot be given to questions which do not bear on subjects that fairly come within the scope of the Magazine.*

I.—Letters from Correspondents.

Broom and Brush Making.—Brushmaker writes:— I see on page 253 of Work an answer to a query regarding broom and brush making which is very misleading. I understand the material your correspondent has sent you a sample of is called bass. It is of a dark brown colour and very stiff; it is used to make stable brooms with. I will try and explain to the best of my abilities the proper way to tie a knot. Say that the holes in the brush-head are ¾ in. in diameter. Take up as much stuff as you think will fill a hole; have your pitch melted; dip the one end in it to the depth of full ½ in., so as the pitch will penetrate through it; then take a piece of thin cord about 12 in. long, and roll it tight at the top; then dip it in the pitch a second time and put it in the hole with the right hand with a half circular turn, just as if you were screwing it in. This spreads the knot and puts it to the bottom of the hole."

A Complaint.—W. W. W. (*London, S.E.*) writes:—"After taking in Work regularly since commencement, and waiting for my turn (wheelwright and coach painting), I was astounded to see the article on Battlesden Cart. I supposed your writers were practical men, not clerks. I supposed Work was for the benefit of beginners and improvers of all trades. In your article on cart the writer doesn't mention birch for panels, elm being seldom used, owing to its being liable to cast in drying; walnut is far too costly. He also mentions elm for shafts, but I have never seen an elm shaft in my life, especially one of that description. To an outsider, no doubt your other articles appear reasonable enough, but having asked the opinion of others in the trades, they say the same, being far too amateurish to be of use to improvers like myself. Most of your subscribers being lads like myself, they will admit that 'Shop' is the best portion of the paper (iron trades and sign-writing excepted). However, I shall stick to it, hoping it will improve and become useful."

Metal for Repoussé Work.—F. U. (*Hereford*) writes:—"I have taken in Work from the commencement, and I consider it really the best of its class published. I have obtained much that is useful from it, and should therefore like (with your kind permission) to call the attention of your readers and workers in repoussé (that is, of those who do not already know it) to a very beautiful metal for this work, far superior to either brass or copper in working and in looks when finished. It is known as aluminium bronze or sun metal. The patentee is Mr. John Clark, 80, Great Brook Street, Birmingham, but no doubt it can be got through any ironmonger. I have just finished a piece of work which put it to a very severe test, and it came out victorious in every instance. I see the metal is patented in Belgium, France, Germany, United States, Great Britain, and India, the price of it being very reasonable."

An Opinion of Work.—Stoker writes:—"Allow me to say a few words about Work. Your correspondent W. V. C. (page 268) says that most of the articles in Work are far above his head. Perhaps so, but why don't he try something that won't require so much skill to make as 'A Cabinet in Fretwork for Skilled Workmen?' It only needs a bit of courage and determination to succeed, and then I am sure he will have no cause to grumble when he looks upon his handiwork. Now, here is an instance that should encourage him. Till I had the first number of Work I had never used a carpenter's tool, and I have never been inside a carpenter's shop, or scarcely ever seen a carpenter at work, so surely I was about on a level with W. V. C. in the matter of carpentry. I had very little money to spare, yet I purchased a small plane for 2s. 6d., begged an old file from the scrap heap, and forged myself some chisels out of it, with the kitchen fire for my hearth and a shoemaker's iron last for my anvil, and then I went to work and made a table as described in No. 1 of Work, with turned legs and plain top. I met with many difficulties, but believing that perseverance conquers everything, I worked away with a will, and succeeded in making a good job of it. I then French-polished it, and here again Work came in, for I had never done any French polishing before, but thanks to Work, I succeeded in this also. And now I have sold the table for what I consider a good fair price, and am going to buy a few tools with the money. I might say I made a lathe to turn the table legs, and the ideas for this I got from Work also, and although it is very rough, it does a lot of good work, and the materials in it only cost me about 4s. 6d. I would send a description of it, but I think it unnecessary after what has been said by Self-Helper in page 261 of Work, and, as you see, I am not good at writing, and I hope my fellow-readers will excuse my badly-turned sentences. In conclusion I beg to state that in my opinion Work is supplying a long-felt want. I am sure it is just what I've been longing for many years, and I heartily thank you for the good it has done for me."

Simple Measurement of Timber.—Timber Trolly writes, in reply to A. G. H. (see page 269):—"A. G. H. does not understand the reason of timber measurement as given by Hoppus in his calculations, or he would not have intruded his views of which is right: by trade usage and fairness in buying and selling; or by cylinder measure. In measuring timber in the round it is usual to allow from 2 in. to 3 in. less circumference for the bark, if on the tree. A. G. H.'s omission of this fact plainly indicates his ignorance of the usage of the trade. Round timber cannot in fairness be measured as a parallelopipedon, as if it were the outside or inside of a mathematical figure—as for engineering calculations—but for what it will fairly produce to the buyer when the sap is hewed off and the timber squared. Having bought and sold many million cubic feet of timber, 'growing,' 'round,' and 'squared,' and knowing the usage in Europe and America, I may state that the system common to all timber-selling countries for measuring round timber is the quarter-girth squared, or multiplied into itself, and the product multiplied by the length of the piece of timber; this product is then divided by 144; if the calculation is in feet and inches the dividend is the answer, as shown in Hoppus. Now for matter of fact. Has A. G. H. never heard of tare and tret, the long-hundred, heap-measure, the barn gallon, the baker's dozen? Timber measure comes under the same category of reckoning, or it would be called cylinder measurement if that plan were used. From my experience, the difference between timber measure and cylinder measure is as 102 to 120, or 18 ft. of that latter measure or less is charged to timber buyers proportionately, as well as several feet less allowed off for bark, according to local custom or sort of timber; and if the tree has a top, even several feet long, that will not square up 6 in. in quarter-girth, that is given to the buyer, if the timber be ordinary English wood. Limbs, in like manner, that will not measure the 6 in., are also given in, if they happen to be left on the 'but.' Is all this giving-in fair? it may be asked. As a seller more often than a buyer, I can affirm it is only fair. How so? Because timber is not sound and serviceable to its outer circumference. The sap of some trees is useless unless specially converted to other purposes than the 'heart-timber' may be used for—as, oak for spokes for wheels, for instance. The 'but' is useless because of the turn of the grain; the top, because too small; even slight curves out of the straight line have to be cross-cut out and thrown aside for other jobs, and every bit of sap must be got off. This sap may be 2 or 3 in. thick in a large tree, so that the sound part of an ordinary oak tree would not yield much more timber than was charged for, by reason of the sap alone, without reckoning 'but' or crooks in the piece. A variety of chances rise against a tree turning out well when opened. Perhaps it has been stricken by lightning, which even a critically experienced forester cannot always detect, as the five radiating shakes from the heart to outer rings do not show when the bark is on, and sometimes even when the bark is off. The tree may be hollow, or gnarled, or have stones and iron nails in it; even a cannon shot has been found in the sound wood of a tree, and the saw is damaged in finding it. ('The Technics of Forestry,' illustrated in the *Journal of Forestry*, by Rider, St. Bartholomew Close.) It must not be forgotten timber in the round does not represent cost commercially so much as sawing does, which the buyer has that to incur. It might surprise A. G. H. if he had his round log cut down the middle, or 'opened,' as it is called, and the measure showed 80 square feet, to have to pay double for that cut, or for 160 square feet; yet it is the rule of pit sawyers of round and even square logs; and as an arbitrator and referee on sawing matters, I feel sure it is only fair, as it is a payment for the labour of 'hewing,' 'pitting,' 'dogging-down,' 'lining,' and 'hauling' the cut stuff to stack, done by sawyers who make this charge; for on 'opening,' the tree may be 'hollow,' 'doated,' or worthless, and no more cuts put into it, all after cuts being actual square measure reckoning. Did A. G. H. ever buy a plank cut from round timber with a section thus?

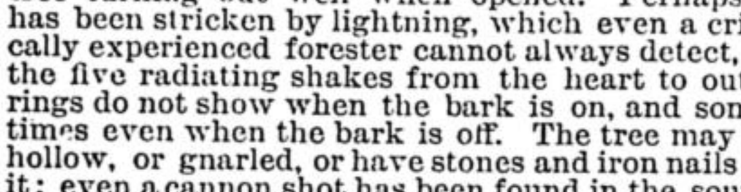

Diagram showing "Wane" of Timber.

The triangle called the 'wane' of the timber, A, C, D, is not measured, but the other 'wane' is, to half its measure, as shown by the dotted lines B, F; thus the buyer of plank has some of the round timber and sawing given to him. If the plank is less than, say, 30½ feet long by ½ in., the bare half foot, or 5½ in., is given to the buyer; this, with the sawing, has been paid for, with all its risks, by the round timber purchaser. If this lesson in timber dealing does not convince A. G. H., let him buy a carpenter's slide rule marked for round timber measure, no matter of what nation, or one of the more elaborate sets of logarithmic scales with gauge points for round timber measure, and test my experience by them, and he will find Hoppus's calculations right. But a visit to a wheelwright in the country, who deals in round timber, with a few questions, will, if intelligently made, teach him the difference between common sense and knowledge: one is the applied science of everyday life, the other may be only the recollection of a dunce or the oracle of a fool—if mere blind book learning which may mislead the inexperienced."

Proportions of Lathe Fly Wheels.—J. W. C. (*London*):— I have received a very silly letter, through the Editor, from an anonymous correspondent, signing himself "J. W. C.," giving his address very precisely as "London;" *re* my reply to J. P. A. on p. 220 of Work. As I much question if the Editor will sully the pages of his journal with my correspondent's sneers, I will mention in brief that J. W. C. speaks of my sketch as "that wonderful design of a tight-laced figure 8," as a "pretty piece of figure skating, but somewhat far fetched, and just a little too much *work* in it," and as an "antiquated idea." After a maundering "tale of the Ark," J. W. C. triumphantly flourishes before my benighted and antiquated mind a "problem" reclaimed from Noah's stomach by a "wily" engineer "in his greed for knowledge." This elegant correspondent informs us how Noah had worked out the problem on the skin of the hard-boiled egg which he was eating; hence the "wily" engineer employed a stomach pump for the reclamation of this famous "problem." The problem is that 1 + 2 = 3, and 2 + 1 = 3, whence the obvious inference that, instead of giving the method on p. 220, "with just a little too much *work* in it," I ought simply to have said that the sums of the diameters of each pair of pulleys should be alike. Passing by the sneers in which J. W. C. indulges, I ask him if he thinks that I, who have been among belts and pulleys daily for nearly thirty years, would, in this particular case, commit so stupid an error as that embodied in his arithmetic. J. W. C. imagines that the problem is the same when the centres of pulleys are very near as when they are an infinite or a long distance apart. In stepped pulleys whose centres are not far apart, as in the lathe matter in question, this arithmetic 1 + 2 = 3 and 2 + 1 = 3 does *not* hold good, because the angle at which the belt runs on to and leaves the pulleys has to be taken into calculation, and this governs the proportion of circumference of the pulleys embraced by the belt. If it were simply a case of 1 + 2, etc., why the elaborate formulæ for belt lengths given in the books (see Unwin and others) where trigonometrical functions of the angle θ are employed? These formulæ are Greek to most workmen, and I, therefore, gave a graphic method that everybody could understand, and certainly do not think I put "too much *work* in it." Yet it seems that it is not sufficiently clear to the dense intelligence of J. W. C. But will J. W. C. be good enough to set out stepped lathe pulleys as on p. 220 according to the 1 + 2 = 3 theory, and then set them out according to my directions? Having done so, will he take a pair of dividers, and step round the path of the belt on each pair, and acquaint the readers of Work with the result, omitting the stupid rigmarole about Noah, which would probably be "declined with thanks by our friend Sloper, and is certainly unfit for Work?" For myself, I may say that, though I have been at the pains to correct J. W. C. in this matter, yet in future, when assailed by an ignorant and anonymous and ungentlemanly correspondent, I shall, whether in the right or wrong, treat the communication with the silent contempt which it deserves.—J. H.

II.—Questions Answered by Editor and Staff.

Coach Building—the "Cant Board."—T. T. (*Kennington*) writes:—"If you are not tired of hearing them, allow me to offer you a few words of praise and my testimony as to the usefulness of Work. In my humble estimation it is the one thing that was needful. May I be allowed to ask at the same time if it is a part of your programme to give any practical papers on coach building? It seems in most books to be entirely neglected—why, I know not. I hope Work will be an exception. I happen to be a body maker (improver), and some papers on that subject, especially on the 'cant board,' would be read with great pleasure, and profit, no doubt, by myself."—[I think we must be content to regard Work as one of the things that are needed, and not as the "one thing needful," which is a matter of far higher and greater importance, as you will see if you turn to St. Luke x. 38-42. Your request with regard to coach building generally, and the "cant board" especially, has been forwarded to a skilled coach builder, who will take the matter in hand.—Ed.].

Leclanché Battery for Disposal.—J. C. F. (*Otford*).—Advertise your battery for sale in the "Sale" column of Work. The cost will be one shilling for twenty words. Or advertise it for exchange for something useful to the value in this paper, *The Bazaar, Exchange and Mart*, or *The English Mechanic*.—G. E. B.

Electro-Plating.—J. T. D. (*Sunderland*).—I hope to give full instructions on the art of electro-plating in some future number of Work, in a style easily understood by amateurs and young workmen. Meanwhile you may learn much from my occasional "Notes for Electro-platers." The best book on the subject is "Electro-deposition," by

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A. Watt, latest edition, price 12s. 6d. I am glad to know that such a young amateur electrician is taking an interest in electro-plating. I shall be very pleased to give you instructions in "Shop" if you meet with any difficulties in your studies.—G. E. B.

Dry Plates.—TORTOISE-SHELL TOM (*London*).—The preparation of your own dry plates would be a tedious and troublesome job, and unless you are possessed of a large stock of patience and a cheerful temperament, I would not advise you to attempt their manufacture; better buy the larger size, as you are doing, and cut them down. But why not alter your dark slide, or insert a carrier to take ½-plate size? Then you would be working to a recognised standard, and plates, paper, mounts, and developing dishes could be used more economically, and you would have no waste, as at present. To coat plates requires a rather heavy outlay for apparatus, and the actual process occupies a deal of time, while the result, even when the greatest pains are taken, is often failure, besides which even a brief summary of the process would, to be intelligible, take up about a couple of pages of WORK. For further information on the subject, you should procure Burton's "Modern Photography," price 1s., where you will find at page 143 full details of the coating of dry plates and formulæ for emulsion-making. Cassell's also publish an excellent shilling book on "Photography for Amateurs," by T. C. Hepworth.—G. LE B.

Electric Bell.—AMATEUR G. A. S. (*Stepney*).—As your bell stopped ringing when the armature was pressed to the cores, and did not recover itself when the finger was removed, this showed that the cores retained some magnetism after the circuit was broken. This defect was confirmed by the experiment you tried with the iron filings, since they also stuck to the cores after the circuit was broken. The iron of the cores is therefore, hard. Now for the remedy. The surest is, to take out the cores and anneal them as directed on page 180. Sometimes (unless the iron is very hard) the sticking propensities of the armature may be remedied by pasting a bit of paper (gummed paper from postage stamps) on each of the cores. The magnets for a 4-in. bell will take 47 yards of No. 22 B. W. G. silk-covered copper wire. This will weigh nearly six ounces, and cost about 2s.—G. E. B.

Magnet.—FLAX SPINNER (*Longton*).—The information you give respecting your battery and horse-shoe magnet is insufficient to work upon. I must know exactly the diameter of the magnet cores as well as their length, as I shall have to calculate the cubic contents of the iron in the magnet to arrive at its capability for receiving magnetism. Therefore kindly oblige by giving me the *length* and the *diameter* of the magnet legs, and I will then tell you the size of bobbins to be placed upon them, together with the gauge and length of wire to be wound on the magnet. As the magnetic force developed in the iron of an electro-magnet is proportionate to the strength of the electric current passing around its coils, I must also know the number of cells to be placed at my disposal, as well as the size and nature of the plates. It is not enough to say you "have a lot of Smee cells;" I must know *how many cells*. By-the-bye, your cells are not Smee's, but Walker's, as shown by the carbon plates. The electro-motive *force* of both is low, and not at all suitable to develop the full power of an electro-magnet. I will try to instruct you how to alter your battery, too, if you will write again and give all particulars.—G. E. B.

Corner Bookcase.—E. S. (*Clapham*).—I have a design and description of a corner bookcase, which will appear shortly, and which you may be able to adapt to your own special requirements. It is seldom possible to do more than give a good type of the article required, but this done, advice and suggestions with regard to modifications desired by correspondents can always be given.

Overmantel.—BRUSHMAKER wishes to make an overmantel with mirrors and fretwork panels, and desires a design for one in WORK from the pencil of Mr. J. W. Gleeson-White, and adds, "I have made up one of his designs already, which I exhibited at the Glasgow Exhibition last year." I am sure Mr. Gleeson-White will be as pleased as I am to hear of your success. I have many beautiful designs from his pencil awaiting publication, and in course of time you shall have a design for an overmantel in fretwork.

Hot-Air Engine.—C. J. W. (*Beccles*).—Space forbids any further attempt to notice articles of any kind on show at exhibitions. A mere cursory mention of them is of little, if any, practical use, and it is not possible to devote to it the room that the subject demands. For this reason I cannot give a review of the machinery at the Royal Agricultural Society's Show at Windsor. But as soon as it can be managed, descriptions will be given of engines and motions, including a hot-air engine.

House Repairs.—AITCH.—Articles on general house repairs would have to be hypothetical to a certain extent; that is to say, we must first suppose certain damages and the causes thereof, and then describe process of repairing according to the supposition. The term "general house repairs" covers a wide area. If there are any particular repairs that you wish to carry out, put a question to us on the subject, and you shall receive instructions through the medium of "Shop." I am glad you found the first paper on Burglar Alarums "very good, and quite interesting, also instructive."

India-rubber Stamp Making.—HALLAMSHIRE.—When I can meet with any one who can and will write on this subject a paper or two descriptive of the appliances and materials used and the process to be followed, it shall be given. I must, however, first catch my writer. Probably this reply to your appeal may bring a volunteer to the front.

Photographic Camera.—H. M. (*Oldham*).—The construction of the camera is already commenced. With regard to the cost of lens, it is not possible for me, being in ignorance of the sort of lens you want, to name a price. The best course you can adopt is to send for the price list of any dealer in photographic appliances, and select for yourself the kind of lens that will meet your requirements in price as well as other points. In the "Photographic Annual for 1889," issued by Mr. Jonathan Fallowfield, 35 and 36, Lower Marsh, Lambeth, S.E., which, in fact, constitutes his price list, twenty-six pages are devoted to description and prices of lenses. You can get lenses at all prices from 4s. 6d. to £50, and even more, but good lenses for ordinary purposes may be bought from £1 to £5. It might be useful for you to watch the photographic journals for advertisements of lenses to be sold cheap by those who wish to part with them.—E. D.

Working Drawings to Scale.—E. J. E. (*Abingdon*).—For the benefit of yourself and others who find a difficulty in reading and understanding working drawings to scale, an explanatory paper shall be written on the subject. You will find "Drawing for Carpenters," published by Messrs. Cassell and Co., Limited, a most useful book. It will not be possible to comply with your suggestion to enlarge WORK and raise the price to 3d.

Index to Numbers.—BARRHEAD writes:—"If the contents of each number were printed in small type over the top of the word WORK on the front of each number, I think it would be of great assistance to any one looking for a certain article that he remembered having seen in some back number. It would save his looking all through each number." In reply to your suggestion, which is a good one, the position proposed would not be a convenient one for index to numbers; it would come in better under the date, but as so much room is wanted in the front page of some numbers for cuts, it would be difficult to provide for an index in this page. Still there is so much reason in your suggestion that it shall have careful consideration.

A Wooden Affair.—PROGRESS writes:—"I have taken WORK in monthly parts from the beginning, and was induced by your prospectus to do so, there being many subjects mentioned about which I should like information, particularly watch-jobbing, horology, and other kindred arts, but up to the present your WORK has only been a wooden affair, and I am glad to see you had complaints from other subscribers. Evidently you put your trust in wood, and I hope it won't fail you, for you will have none but wooden customers unless you give a better all-round pennyworth. Of course, you can't give everything at once, and so I shall continue to take it in till it has had a fair start, and as questions are permitted I will ask one or two."—[The prospectus did not say that every subject was to be commenced and dealt with at once. You will not be long without information on watch-jobbing at all events. "Like cures like," the homœopathists say, and "like seeks like," in accordance with the old saying, "Birds of a feather flock together," so that you may trace if you like the woodiness of WORK to the material of which its Editor's head is constructed. Yes, I certainly like wood working myself, although it can hardly be said of me that I put my trust in it altogether. Wood is a material that is far more tractable and easily worked than metal, and hence it is that wood working finds favour among the majority of those who take up manual labour as a hobby. Moreover, the outcome of this is that it is far easier to get writers on carpentry, joinery, and cabinet making than on other subjects, which, although quite as important, are, perhaps, not quite so popular. But you will find plenty to interest you, as successive numbers appear, even in your own particular subjects.—ED.].

Watch Maker's Mandrel.—PROGRESS.—For my own part, I prefer a largest size "Boley" turns, with universal head and extras, as then you have a good combination tool, but if cost is no object, then a good American lathe, with a mandrel head. To fit a new jewel, if the setting is bad, I should think you could turn out a new sink with a fine lozenge graver, but must confess I have never done so, as when too bad to hold a jewel have usually sent to a jeweller's.—A. B. C.

Spinning Tin Plate—J. C. G. (*Nenagh, Ireland*).—I quite agree with you that spinning in the lathe is a fascinating art, but it requires much practice. Tin plate can, to a limited extent, be spun in the lathe, but to nothing like the depth you name. In trade a great deal of work that used to be spun is now pressed. I cannot give you the amount of pressure to apply; it will depend upon the thickness and quality of plate upon which you are engaged; this and the velocity are best found by trial. You should begin with a light pressure and gradually increase it, but you must be careful not to increase it too suddenly. You cannot anneal the plate without burning the tin off; but why not get the charcoal plate and spin it, and then tin it afterwards? You could then anneal it as often as you liked. Tin plate is not a favourable material, because the iron will not "flow." You would find Britannia metal work better. I believe the best account of spinning metal is to be found in Holtzappfel's "Mechanical Manipulation."—F. C.

Brittle Electrotypes.—A BEGINNER (*Foley Street, W.*).—In your case, the brittleness of the electro is evidently caused by too much current. In making such small electros as you describe, and in copying coins, you must adapt the surface of the zinc in the battery to the size of surface to be covered, or use fine connecting wires so as to reduce the volume of current. The current may also be reduced by exposing a small surface of anode to the solution (the size of anode should always be adapted to size of mould), and by placing the anode and mould farther apart in the solution. A few practical experiments embracing those varied alterations will soon put you in the way of getting good, tough copper. The solution may have something to do with your failure. The best is made up of:—Saturated solution of copper sulphate, 6 pints; water, 2 pints; sulphuric acid, 16 fluid ounces. You do right in using the large Daniell cell.—G. E. B.

Photo-lithography.—J. P. (*Glasgow*).—When a suitable opportunity offers, this subject shall be touched on.

Model Yacht and Boat-building.—There are so many subjects on hand just at present that some of them must of necessity be cleared out of the way before this and others can be taken in hand.

Catapult.—G. S. W.—You say:—"Could you tell me how to make a catapult in a proper and scientific manner—not a mere child's toy, but one that is capable of throwing a long, straight, dead shot—giving details as to size of shot used, material, whether wood or wire, and how to make it properly?" To this I can only reply, I could, but I would much rather not, as the girl said when her father told her to come off the grass. Catapults are dangerous things; and, as I am obliged to draw a line somewhere, I must draw it at catapults and all things that might be attended with damage to life, limb, and property, if brought into play. However, that you may not be entirely disappointed, I will refer you to Dr. William Smith's Dictionary of Greek and Roman Antiquities for information on the balista and catapult—ancient engines of war that were capable of doing all you want or wish for in the way of throwing "a long, straight, dead shot," and did it well, too.

WORK behind Time.—C. H. C. (*Margate*) writes:—"Can you inform me how the delay is caused through my bookseller not receiving WORK? I have been a subscriber from the commencement of the valuable work, and I don't think it is quite right that the delay should be so long that I never receive it regularly. I should be pleased if you could assist me at all."—[Your bookseller ought to have WORK for each week on sale on Thursday morning at the latest, Wednesday being the date of publication. I cannot *tell how* the delay is caused; but I have a suspicion that it is either through the remissness of the bookseller's London agent, or the inability or disinclination of the bookseller to look properly after his business. If I did not get things up to date myself I should try another bookseller.—ED.].

Upholstery Work.—G. P. (*Bristol*).—Carpet planning cannot be treated of in these pages yet awhile, as there are many subjects of more general interest awaiting their turn. Bed hangings have been under consideration, and a design may now and then be given, but, like the former subject, this must wait, unless I should find I am mistaken in supposing that there is no large demand for instructions on this kind of work. As you are, no doubt, aware, if I may judge from the heading of your note, with the exception of planning, etc., draperies, the actual making up is done mostly by women, and WORK is a magazine for men. The same objection does not apply to stuffing and general chair upholstery, which will take its turn with other subjects. An article on making, stuffing, and covering a chair will shortly appear. I cannot advise you to attempt to make your own buttons as per sample sent. As a matter of business, it would not pay you to do so, and surely you have no wish to make them *en amateur*. You can buy the buttons for far less than it would cost you to make them, and I take for granted you know how to cover them whenever it may be necessary.—D. A.

Electric Light for Photo Dark Room.—CORRESPONDENT.—Procure a six-volt 2½ C.P. lamp. Rig up a four-cell battery, double carbons, with single zincs between, each plate being 2 in. by 6 in. by ¼ in. Let the cells in which these dip hold not less than a pint of liquid. Attach the elements to a board as long as the four cells together, and as wide as one. Connect the elements in series. Attach a hook at each end of board, and, by means of a pair of catguts and a weight, counterpoise the whole, so that the entire arrangement can be lowered into, or withdrawn from, cells by a mere touch of the finger. Charge the cells with:—Chromic acid, four ozs.; water, one pint; sulphuric acid (1·840), three ozs. by weight. Mix and allow to get quite cold. Couple up to lamp by means of well-insulated wires. When using, lower the plates only so far as is necessary to give the required light, since at the start, when the solution is fresh, so much current is produced as to endanger the lamp if the whole length of the plates is immersed at once. If your lamp is of higher volt size than six volts, you must use correspondingly more cells, allowing one cell for every two volts over the first four.—S. B

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Dressers. — GIMLET (*Coventry*). — An article describing the construction of one of these useful pieces of kitchen furniture will appear ere long. Meantime the following hints may be of service to you. As I gather from the nature of your inquiry that you are not a practical joiner, fasten the parts together with nails wherever practicable. You will find some valuable suggestions in the description of the overmantel illustrated in our articles on artistic furniture, as well as in other articles treating of cabinet making. Do not attempt sliding doors, but be contented with the ordinary hinged construction. Good, sound pine will do very well for the material, but use the red instead of the white kind, and remember that you will find No. 1 or a good quality cheaper in the end than thirds, though it may not be so low in first cost of timber. Your sketch does not show any plinth, which there certainly ought to be below what you represent as the bottom of the dresser.—D. A.

Bookcase Competition.—CHIPS.—I have given all the information that it is necessary to give in the notice respecting the competition, and all competitors must use their own judgment in preparing designs. You can determine exactly what is asked for from the wording of the notice, and I cannot say any more on the subject. The great object is to elicit the ideas of competitors according to the base of operation set forth in the notice.

Electric Bell Magnet.—J. B. (*Glasgow*).—The magnet of an electric bell should be constructed as described and illustrated on page 180. When two cores are employed, they must be united by a yoke of iron, so as to form a horse-shoe magnet. I have not tried the effect of mounting the two cores on a piece of wood or other insulating substance, so as to form two independent magnets. Small bells are sometimes rung with one core only. Thanks for your expressions of kindly appreciation.—G. E. B.

Mixing Oil of Gold Size. — GILDING (*Walworth*).—Take equal parts oil gold size, linseed oil, and copal varnish, mix well together, and strain through a fine strainer. Young's patent size is equal to parchment size, especially in warm weather, to dry quick. To dry extra quick leave out linseed oil and add terebene.—G. R.

Patent.—MINERVA.—The advice of AJAX was, no doubt, well intentioned, but evidently not very practical. Very few manufacturers or purchasers care to take up an article which is only provisionally protected; they generally ask to know that the complete patent has been applied for. Those who thoroughly understand patents are well aware that this provisional protection is, in reality, a very questionable monopoly, and that no action for infringement would lie against any one for pirating an invention only provisionally protected. All those who have good inventions so protected should lose no time in obtaining their complete patent; and we think that the advice of your agents has been well given.—R. and C.

Silver and Gold Solution.—GALVANUM (*Manchester*).—When you have your nitrate of silver solution ready, add to it a strong solution of cyanide, and when the addition of more cyanide does not cause any further precipitate of silver cyanide, stop adding the cyanide solution, throw silver cyanide on a filter, wash with distilled water, and collect silver cyanide in some vessel. Then add to it one pint of distilled water, with ½ oz. cyanide dissolved in it. Make up to one quart, and then add another ½ oz. of cyanide to it. Do the same with the gold, but, instead of adding ½ oz. free cyanide, add ¾ oz. or one oz. If solution should work slow, add a little more, say, at the rate of one drachm at a time. I have a chain which was in the bath for two hours that has been in use for the last fifteen months, and it is not altered much; but it is very hard to state on such matters as these, as it depends upon mode of working, strength of solution, and experience of the depositor. Your deposit ought to have lasted longer than it did. If you make up a solution as in my article, and use these proportions of cyanide, you will, if you are careful in the depositing, be able to obtain a serviceable deposit. I am at present preparing an article on the use of cyanide of potassium, which, no doubt, will be of great interest to you. If you cannot succeed, write again, and send me full particulars of your process and preparations.—F. W. M.

III.—QUESTIONS SUBMITTED TO CORRESPONDENTS.

Circular Latch Needle Machines.—CONSTANT READER (*Glasgow*) writes:—"Could any of your correspondents to your valuable paper inform me how the cylinders of knitting machines are made and cut, with the easiest way to make them, the tools required, and where such are to be bought?"

Tool Wanted.—GAUGE POINT (*Paris*) writes:—"Wanted, a rule for prompt and accurate measurements to the $\frac{1}{16}$ of an inch of openings and spaces, as doorways, windows, arches, lengths inside tubes, etc., from 2 to 10 ft. It is done variously by workmen, but all are more or less dissatisfied with the makeshift plans they adopt. Something reliable is wanted suitable for all workers, and yet to be a cheap handy tool, bevel for stair-rail joints, a grip vice for veneer or a door, etc. Those who use such tools might give the best they know in a few words in return for what they take."

Carriage Paint. — W. W. W. (*London, S.E.*) writes:—"Will you kindly submit the following query to your correspondents? To make a dark claret colour for carts as on bus panels. Rose pink is the right colour, but it fades even after varnishing, lake being too costly."

Fretwork and Carving.—W. W. M. (*Glasgow*) writes:—"I would like to know if Mr. Henry Zilles & Company, Wilson Street, London, E.C., could supply me with a few designs, fretwork and carving, for a knife-box, same as engraving in WORK August 10th. If he can supply me with a few, to mention the cost?"

IV.—QUESTIONS ANSWERED BY CORRESPONDENTS.

Hand Circular Saw Bench.—A.R. (*Scorrier Saw Mills*) writes in reply to G. H. L. (*Hull*) (see page 222):—"I understand by your question that you wish to make a bench of wood, which will do for such work as you state, if properly put together. The kind of wood I should select would be red or pitch-pine, the frame to be nicely mortised and bolted together with ¾ in. bolts; the top of bench to be 3 ft. 6 in. long, and 2 ft. wide, and about 1 in. thick of hard wood screwed down on the top of frame, so that it may be taken off should the bearings require looking to. The spindle should be of 1 in. or 1¼ in. iron, with three places turned for the bearings, one near the collar washer, one on the other end of spindle, and another a certain distance from the end to set in a bearing fixed on the frame of bench; the end bearing on the outside of bench should be fixed on a horse, and between these two bearings a small pulley should be keyed about 4 in. diameter. This pulley is to take the driving belt, which should be of leather about 2 in. wide, and driven from a wheel, say 4 or 5 ft. in diameter, keyed on a short countershaft about 12 ft. between centres. The rim of this wheel should be heavy, and a handle fixed well up one of the arms to turn it. The belt should be crossed so as to have more grip, and to drive with less tension. The bearing next to the collar washer should be fixed on a piece mortised in the ends of bench, about 8 in. from the side nearest the saw pulley. Saw to be from 9 to 12 in. diameter, and teeth as in a hand rip saw; the timber should be fed very slow, your power being limited. Even this mode of driving a small circular saw will be far from a pleasant job for the man who has to turn the wheel. In fact, all circular cutters should be driven by motive power, as they should attain a high speed, and are continually cutting. Fuller information could be given by giving sketches of bench, etc.; but as I have not time to give sketches now, and at which I am not a good hand, I hope the above will be of some service to G. H. L."

Paste. — THOMASO writes in reply to J. R. (*Skerries*) (see page 238), who wants a paste that he can keep on his office table to use instead of gum—a paste that will not turn bad:—"Personally, I prefer gum for small office jobs (dextrine, or as it is sometimes called, 'powdered gum,' can be got very cheaply at the oilshop, and makes good mucilage), holding the gluepot in reserve for parcels, etc. But the paste. Put a heaped-up teaspoonful of powdered alum into a breakfast cup of cold water, and stir till dissolved. Use this alum water to mix the paste with, and a flat stick of wood to crush all lumps. If properly mixed, the paste will look like cream—or paint. Boil very slowly with constant stirring, until the stick will stand alone. A quarter pint of paste should take about ten minutes to get in this condition. It is, of course, easy to boil it up in a minute or two; but it must be remembered that paste wants *cooking*. I usually tell when it is done sufficiently by smelling it. If not done enough it smells *raw*. This paste can be kept until it dries up into a solid lump. I have never found it go watery, get mildewed, or smell offensive; and it has this advantage over the bought 'office pastes;' it has no strong smelling or perhaps poisonous preservative in it. Better not cover up too tightly, and do not keep it in a tin, or put a tin mounted brush in it, because of rust. An everlasting brush is made by inserting some bristles, cut from an old broom, into the end of a piece of very small lead gas pipe (¼ in. outside measurement), and then smashing the lead so as to grip the bristles, trimming them up with scissors, and inserting a piece of wood into the other end to make it longer, if necessary."

Drilling Square Holes. — F. H. (*Plumstead*) writes in reply to A READER (see page 270):—"In No. 17 of WORK I see a correspondent asks for a description of the scientific method of drilling square holes patented in Austro-Hungary. I cannot give that, but will gladly try to explain a method I have seen practised in my own shop. This would be more correctly described as boring square holes. A piece of steel was fastened in the bell-chuck of a lathe, and a hole was bored up just a little less in diameter than the width of the square across the flats. The outside was turned down so as to let a nozzle on, which had a square hole drifted through in the centre, so as to act as a guide for the squaring tool. This tool was made in the same manner as an ordinary half-round bit for a lathe, except the cutting end, which was made an equilateral triangle, whose side was the width of the square required, and whose length was rather longer than the length of square hole required and the thickness of the guide plate together. The triangular end was inserted into the guide, and the poppet head centre was run up to the back end of the bit, and fed up by it. The bit was held back against the centre by the mechanic, who had fastened a carrier on the shaft of the bit, and at the same time he let one end of the carrier rest on the slide rest to prevent the bit from turning. The lathe was driven in the ordinary manner. Some of the holes made were very good, but, unfortunately, there were about as many bad ones, so that it had to be given up as a bad job."

Trade Notes and Memoranda.

THE number of applications for patents in 1888 exceeded those of the previous year by nearly six per cent., and were 19,103 in number. Of designs, 25,923 were applied for, 568 of which were refused registration, on account of their similarity to designs already registered. The total number of applications for trade marks was 13,315, as compared with 10,584 in 1887.

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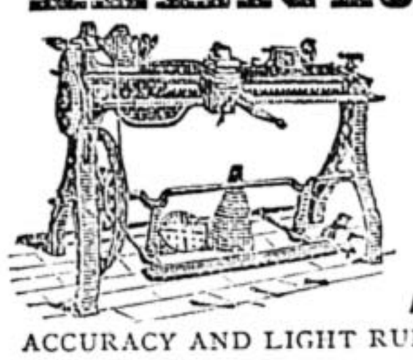

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